POWER PLANT ENGINEERING

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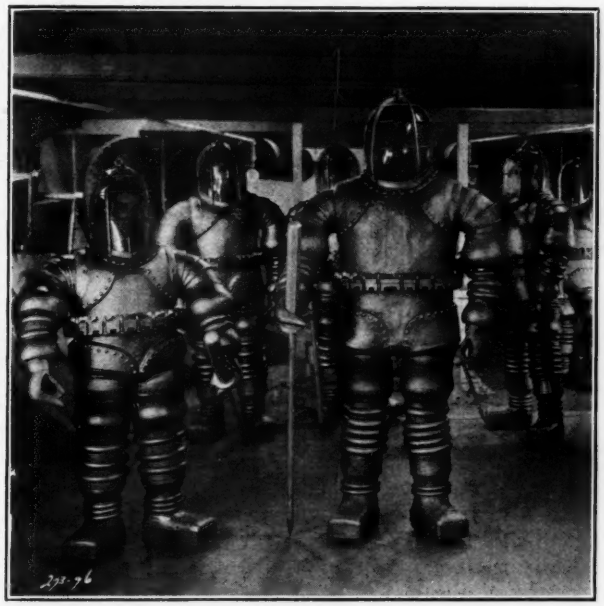


Deepwater Makeup

BEHOLD, ASTONISHED READER, this strange picture. Gaze upon it—rub your eyes. Do you see what we see? Do you see this sextet of tin woodmen or whatever they are? You do? Heavens! so you drank some of that stuff too! But wait, don't jump at conclusions; maybe things are not as bad as they seem. Perhaps this is a real photograph.

Who are these funny looking men and why are they all dolled up in those cast-iron tuxedos? Where are they going?

S-s-h-h—we'll tell you. They are the six big steel men from the Mysterious Island on their way to Deepwater. Wishing to be dressed for the occasion, they have very naturally adopted the conventional Deepwater makeup which, as you will note, is along strictly high-pressure lines. Attired in ensembles of ultra marine, these gentlemen with their galvanized iron spats and their tested Sargol joints consider themselves quite modish. And why not? Are not Sargol joints quite the proper thing at Deepwater?

We should like to tell you more about these underwater sheiks but there isn't room here. Those of you who frequent the cinema[1] may follow their hair raising adventures in the Metro-Goldwyn-Mayer production, The Mysterious Island. What we really started to talk about here was Deepwater makeup, but, after all, there isn't much to say about it, for as you will discover upon reading the article on Deepwater in this issue, the makeup at this station is about one-half of one per cent.

[1]English for Movies.

DEEPWATER—A New I

Not only is Deepwater one of the first large Central Stations to go into operation utilizing 1200 lb. pressure exclusively but it is also one of the first to supply large quantities of high pressure exhaust steam to an industrial plant

OWNED JOINTLY BY TWO electric utility systems, supplying both steam and electricity to a nearby industrial plant, operating entirely from 1400-lb. pressure boilers, incorporating two entirely different systems of pulverized coal combustion and utilizing the most modern methods of obtaining economical heat balance, the new Deepwater Station designed and constructed by Stevens and Wood, Incorporated, without question possesses more features of unusual engineering interest than any other central station constructed in recent years.

True, many of these features considered individually are not new. Twelve-hundred-pound steam pressure boilers, for instance, have been in use for several years but in all cases such installations were merely additions to stations already operating boilers at lower pressures, whereas all the boilers in Deepwater Station are designed for 1400 lb. The use of pulverized coal, also, is established on a sound basis but Deepwater is the first large station built using both the unit system and the central system under the same roof and subject to identical conditions. The fact that all these features are incorporated in the design of a single station makes Deepwater unusual to a high degree.

Perhaps the most interesting feature of all is the sale of steam to an adjacent industrial plant. The relative merits of the central station and the industrial power plant have long been the subject of controversy among engineers and it is a step forward to have a station in which the advantages of both classes of plants are combined in a single system to insure the most economical utilization of fuel. The sale of comparatively low-pressure steam to industrial plants after it has passed through high-pressure steam turbines in a central station is a logical arrangement and the embodiment of this idea in the design of Deepwater is no small achievement in the progress of the industry.

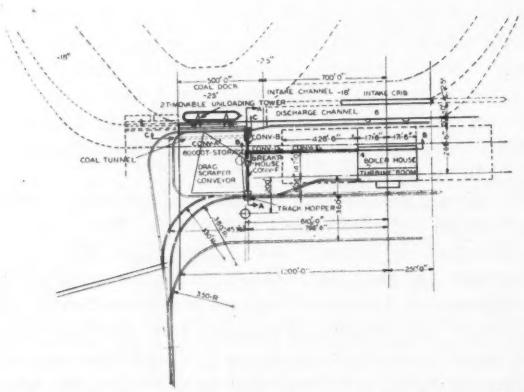


FIG. 1. PLAN OF PROPERTY, SHOWING THE COAL HANDLING SYSTEM AND THE CONDENSING WATER CHANNELS

This station, which goes into service in November, is located on the east bank of the Delaware River about 4 miles south of Penns Grove, N. J. It supplies electric power to the Atlantic City Electric Co., a subsidiary of the American Gas and Electric Co.; the Delaware Power and Light Co. and the Philadelphia Electric Co., both subsidiaries of The United Gas Improvement Co. and also supplies both steam and electricity to the plant of E. I. Dupont de Nemours & Co. adjoining the station, about 1500 ft. distant.

The station is owned jointly by the American Gas and Electric Co. and The United Gas Improvement Co., but is operated and managed by the Delaware River Manufacturing Co. in the common interests of the owning companies.

Although the station is planned for an ultimate capacity of 400,000 kw., the present installation consists of a total of 118,500 kw. divided as follows: One 53,000-kw. unit for the American Gas & Electric Co., another 53,000-kw. unit for The United Gas Improvement Co., and one 12,500-kw. unit for the Dupont Co. All turbines operate at 1200-lb. steam pressure and are designed for steam at the throttle at 725 deg. F. total temperature. The two 53,000-kw. turbines are cross compound units, each consisting of an 11,000-kw. high pressure element and a 42,000-kw. low-pressure element, the latter operating at approximately 400 lb. pressure and exhausting into a 42,500-sq. ft. condenser, designed to operate at a pressure of 1.0 in. mercury absolute. Steam leaving the high-pressure elements is reheated by reheat boilers before entering the low-pressure elements.

The 12,500-kw. turbine supplying the Dupont Co. is identical in design with the 11,000-kw. high-pressure elements of the cross compound turbines. The exhaust from this unit, however, which amounts to 530,000 lb. of steam per hour at full load, passes directly to evaporators, which deliver 400,000 lb. of vapor per hr. at 180 lb. pressure. This steam is delivered to the Dupont Co. but before leaving the station is superheated to 440 deg. F. total temperature by live steam superheaters taking steam at 1200 lb. The condensate from the evaporators is returned to the station boiler feed system. While the Dupont machine is arranged to

w Idea in Central Stations

operate in conjunction with the evaporators, it can be incorporated in a cross compound unit, similar to the other two machines should future developments in energy disposal make it desirable to do so. In this event, the space now occupied by the evaporators would be utilized by a low-pressure turbine and condenser.

These three turbines are supplied from six boilers, all operating at 1350-lb. pressure and arranged so that each turbine is served by two boilers. The cross compound units are each served by a standard boiler and a reheat boiler, but the Dupont boilers are both standard, since no reheating of steam is required.

To meet the requirements of joint ownership, the station is divided into three units. Additions may be made to either the American Gas and Electric Co. section or to The United Gas Improvement Co. section without affecting the joint ownership arrangement. The station can be extended at both ends. The Dupont section is in the middle and the utility sections at each end.

An extremely interesting feature of the station is the fact that two different systems of fuel preparation are provided. Pulverized coal is burned throughout but two systems of pulverizing are used, the bin or central system and the unit system. This arrangement was adopted largely in order to determine the relative performance of the two systems under practically identical conditions. Since The United Gas Improvement Co. favored the bin system and the American Gas and Electric Co. the unit system, the facilities were so divided. The relative performance of these two systems under practically identical conditions will be regarded with great interest, since this installation provides an excellent opportunity for determining the respective merits of the two systems.

Several things of interest are found in the design of the electrical system. Most interesting perhaps are the three switchrooms underneath the turbine room floor adjacent to the turbine foundation structures. These switch rooms contain all the auxiliary circuit breakers and control equipment for the 2300-v. auxiliaries operating in conjunction with one generating unit and two boiler units. There is a separate switchroom for each generator. All circuit breakers in these rooms are operated from the main control room.

As was the case at the Toronto station of the Ohio River Edison Co. and since then in other plants, the wall between the boiler and turbine room has been omitted. This was eliminated so as to improve ventilation, lighting and supervision.

All auxiliaries are motor driven. No provision is made for house turbines as there is reliable power from the interconnected lines of the American Gas and Electric Co. and The United Gas Improvement Co. system.

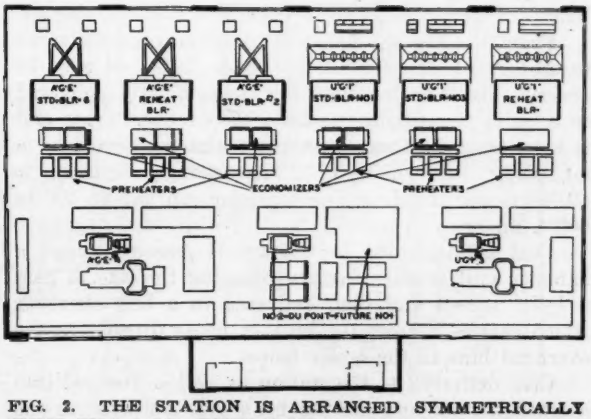


FIG. 2. THE STATION IS ARRANGED SYMMETRICALLY WITH THE A.G.E. EQUIPMENT ON ONE SIDE, THE U.G.I. ON THE OTHER AND THE DUPONT UNIT IN THE CENTER

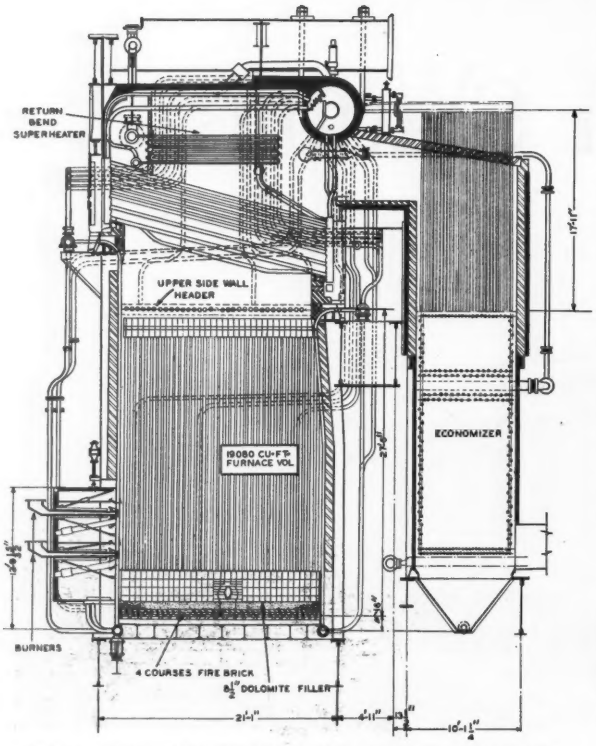


FIG. 3. SECTION THROUGH ONE OF THE STANDARD BOILERS

With this preliminary description of the general features, we can now proceed to discuss the design and constructional features in greater detail.

Coal Delivered Both by Rail and Water

Facilities are provided so that coal may be delivered to the station either by water or by rail. For water delivery, an electrically operated movable unloading tower is installed at the coal dock. This tower places the coal directly over a long concrete tunnel which is built parallel to the unloading dock and is provided with a number of openings at the top so that the coal stored above may be drawn through these openings directly onto a belt conveyor installed in the tunnel. This conveyor delivers to a cross conveyor which carries the coal up an incline to the breaker house where it is reduced in size to pass 1½-in. openings by a 12-ft. Bradford breaker having a capacity of 300 t. per hr.

From the breaker house the coal may be delivered to storage or directly to the boiler house as may be desired. If it is intended for storage, it is delivered to a point immediately outside the breaker house and is then carried to any point in the storage yard by a 4-t. drag line conveyor. The storage capacity is 60,000 t. and the drag line conveyor can handle 300 to 600 t. an hr.

Coal not intended for storage is passed through a hammer mill crusher further reducing the size to pass a ½-in. screen and then delivered to a belt conveyor which carries it from the breaker house directly to the overhead bins in the boiler house.

Coal delivered to the station by rail is dumped into a track hopper and carried by a belt conveyor to the breaker house. The whole arrangement is symmetrical with respect to the breaker house, railroad delivery coal entering on one side and water delivery coal on the other.

As arranged at present, the coal handling equipment has a capacity of 300 t. per hr. but an ultimate capacity of 600 t. per hr. is planned.

In the boiler room, the coal is distributed by means of a traveling tripper to overhead steel coal bunkers running the entire length of the building. Here the similarity between the American Gas and Electric Co. section and The United Gas Improvement sections of the boiler room ends.

On the American Gas and Electric end of the boiler room, raw coal passes directly from the raw coal bunkers through the automatic recording scales and magnetic separators to the pulverizers which are installed on the basement floor level. From the pulverizers, the powdered coal is drawn by exhausters, one for each mill, and blown directly to the burners. The arrangement will be evident from the accompanying cross section.

In this half of the boiler room, there are six pulverizing mills, two for each boiler. The mills are of two kinds, three being No. 38 table type units and the other three, No. 54 pusher type units. Each mill has a rated capacity of 20,000 lb. per hr., pulverizing the coal so that 70 per cent will pass through a 200-mesh screen.

On The United Gas Improvement side, raw coal is delivered from the overhead bunkers through automatic coal scales and magnetic separators to three six-roller pulverizers, each having a nominal capacity of 15 t. per hr. From the mills, the pulverized coal is drawn into three 9-ft. diameter collectors where the coal is separated from the air and the coal passed through rotary air locks either to a screw conveyor which distributes the coal to the pulverized coal bins or directly to the individual bins.

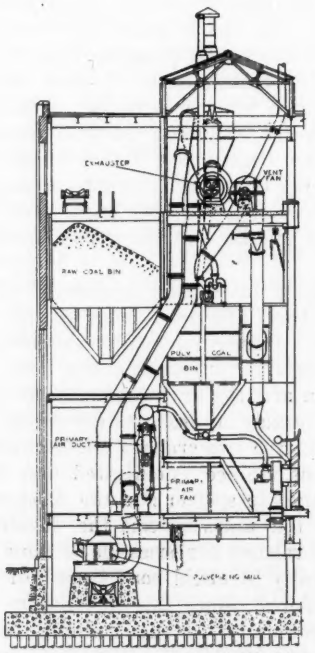


FIG. 4. ELEVATION OF THE BIN SYSTEM OF PULVERIZED COAL HANDLING

The collectors are served by three No. 14 exhausters installed on the upper floor of the boiler room. The collector, together with an exhauster and a mill forms a closed system. Warm air from the air preheaters, however, is introduced into this system at the mills, and a similar amount is withdrawn from the system at a point just after the air leaves the exhauster fan, by the vent fans. These fans, of which there are three, are installed adjacent to the exhauster fans, and deliver the vented air to the burners, as may be noted on the cross section, Fig. 4.

Primary air for combustion is supplied by three fans, each having a capacity of 20,000 c.f.m. at 10-in. static pressure. Primary air is delivered to a header running the entire length of the three boilers fired by the bin system. Each boiler, however, is provided with an individual primary air header from which six lines extend to the pulverized coal feeders and the burners. No separate driers have been provided for removing moisture from the coal, either in the bin system or the unit system. Preheated air is supplied to the pulverizers in sufficient quantity to dry coal containing 10 per cent moisture.

The pulverizing equipment for the bin system has a capacity of 30,000 lb. of coal per hour for each boiler.

On this side of the station (the U. G. I. side), each furnace is provided with six turbulent burners. On the American Gas and Electric side, each boiler has four burners, these being cross tube type burners each having a maximum capacity of 10,000 lb. of coal per hour.

Boilers to Be Operated at 1350-Lb. Drum Pressure

While the six boilers installed are all identical, two of them are referred to as reheat boilers. The only difference, however, between the standard and the reheat units is that, in the latter, a part of the economizer section is replaced by a reheat boiler section.

All boilers are cross drum units with 9000 sq. ft. of heating surface and each of the four standard units has 18,326 sq. ft. of heating surface in return bend steaming economizers placed directly in back of the boilers. The economizers as well as the boilers are all built for a maximum working pressure of 1400 lb. The economizers on the reheat boilers have 4765 sq. ft. of heating surface.

Boiler drums are 50 ft., 3 in. long, 52 in. inside diameter have walls 4 in. thick and weigh 65 t. The standard boilers have a maximum output of 331,000 lb. of steam per hour with an efficiency of approximately 86 per cent.

The reheat sections on the two reheat boilers, each consist of 25,155 sq. ft. of heating surface, in 2-in. tubes 32 rows wide and 60 tubes high.

Each of the six boilers is provided with a return bend convection type superheater, designed for heating the steam to a total temperature of 725 deg. F.

In the installation of the boiler equipment and the associated piping, extreme care was used to make every joint absolutely tight. All joints on the economizers and boilers are of the Sargol type but it was required that these joints be tight at 2100 lb. pressure before welding.

While the furnaces on all six boilers are essentially alike, because of the different types of burners installed on the direct fired and the bin system furnaces, there is a slight difference in the heating surface of these respective types of furnaces. All furnaces are of the flat bottom, slagging type, with bare tubes backed with independently supported refractory walls, and having 19,080 cu. ft. of furnace volume. The furnace bottoms are of steel plate on which is laid four courses of loose fire brick and surfaced with 8½ in. of "Dolomite" filler. The water walls extend around all sides of the furnaces.

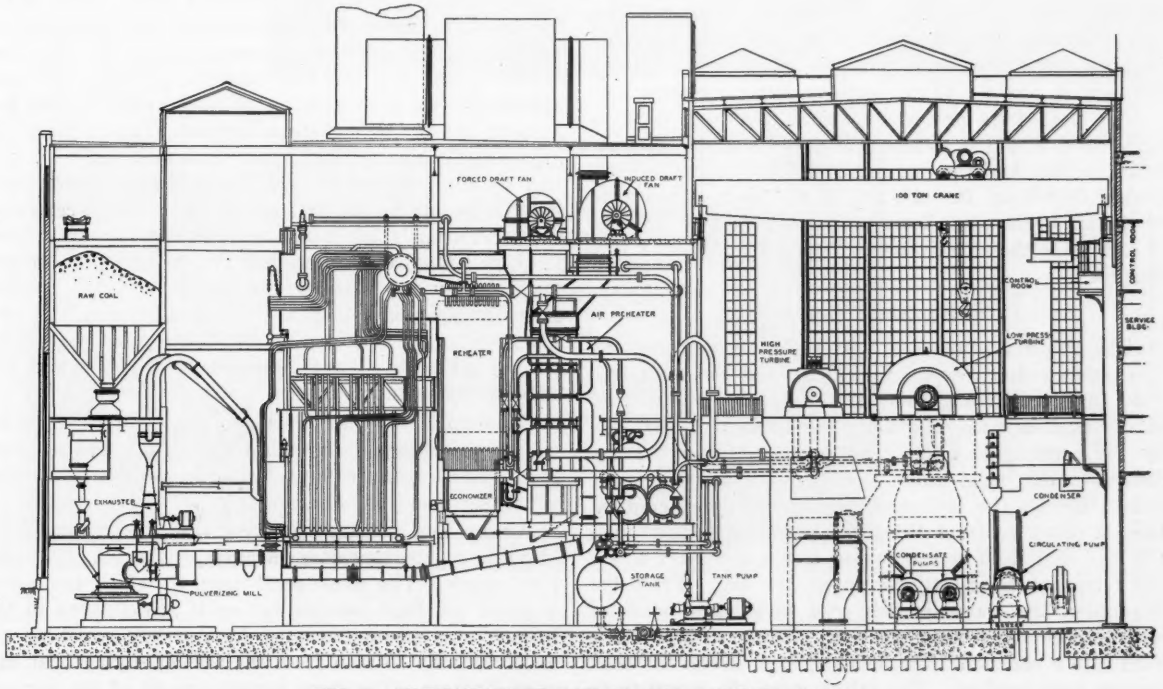


FIG. 5. ELEVATION OF BOILER AND TURBINE ROOM

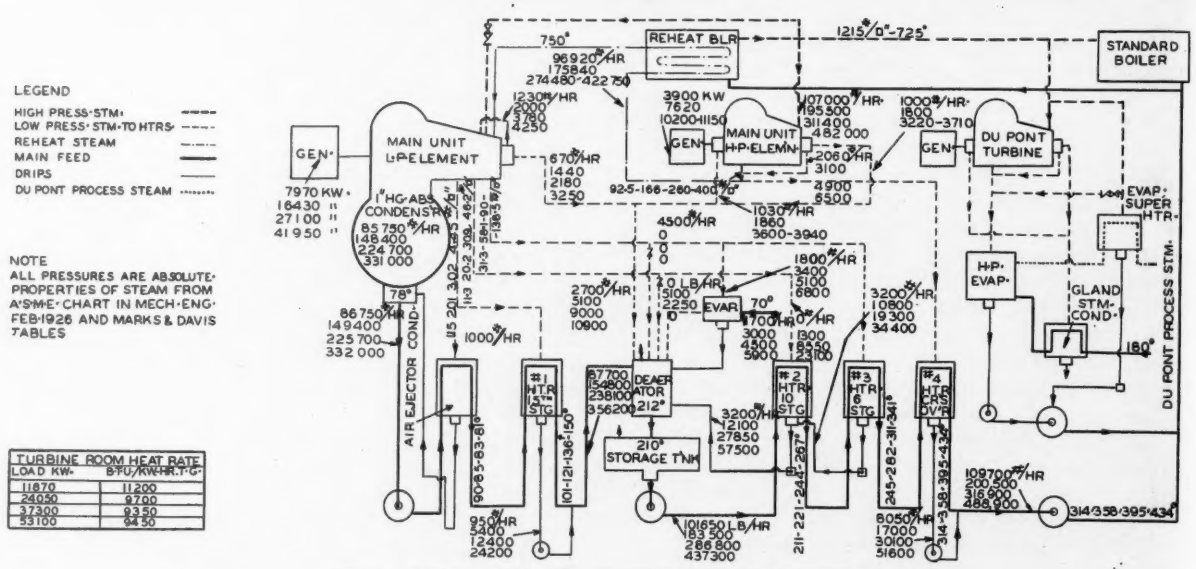


FIG. 6. HEAT BALANCE DIAGRAM OF DEEPWATER

The furnaces are designed for a heat liberation of 22,640 B.t.u. per cu. ft. per hr., and for coal running about 13,500 B.t.u. per lb. having up to 10 per cent ash and 10 per cent moisture. The station is designed economically for four dollar coal.

Forced and Induced Draft

Both the forced and induced draft fans are placed in the upper part of the boiler room, at a point directly over the air preheaters. This is not only the most logical arrangement but makes possible additional heat saving by utilizing the warmer air which naturally collects there. Each boiler is provided with one forced draft and one induced draft fan. The former are of the full housing, vertical down discharge type having capacities of 75,000 c.f.m. at 80 deg. F. against 10-in. water pressure and equipped with vane control. The induced draft fans have capacities of 150,000 c.f.m. at 325 deg. F. against 13 in. negative water pressure.

Air preheaters are of two sizes, the four used in connection with the standard boilers having 46,600 sq. ft. of surface and the two used with the reheat boilers, having 52,800 sq. ft. All are of the plate type. One of the air heaters has been equipped with soot blowers, to determine the effectiveness of the soot blower for this purpose.

Feedwater System

The boiler feedwater is handled in two stages, the first raising the pressure to 650 lb. and the second to 1550 lb. The arrangement of the system is indicated in the heat balance diagram. Condensate is delivered by the condensate pump first to the air ejector condensers where it is heated to about 90 deg. Next it passes through the 15th stage heater where the temperature is raised to from 101 to 150 deg. depending upon the load and from here it is sent to the deaerator where the temperature is stepped up to 212 deg. From the deaerator, the water is delivered to storage tanks of which there are four at present. These storage tanks feed into a common 16-in. header, from which the tank pumps take suction. The latter raise the pressure to about 650 lb. and at that pressure the water is sent through the 10th stage, 6th stage and the crossover heaters successively where the temperature is raised to between 314 and 434 deg. At this temperature, it enters the feed pumps and is delivered to the economizers at a pressure of around 1550 lb. The tank pumps which raise the pressure to 650 lb. are six-stage units, each with a capacity of 650,000 lb. per hr. The boiler feed pumps, which raise the pressure from 650 to 1550 lb., are 5-stage units also rated at 650,000 lb. per hr. There are four boiler feed pumps for the station system and two for the Dupont system.

Make Up Feedwater Is Evaporated

All makeup water is supplied from deep wells through evaporators to minimize scale and corrosion in the boilers. The auxiliary steam system for the condenser steam jets, the soot blowers, priming jets and general service is supplied at suitable pressure from the Dupont 180-lb. process steam system. This reduces the amount of makeup water required for the 1200-lb. system to a minimum, in fact the makeup requirements may be as low as one-half of one per cent. Feedwater contamination is minimized by reducing the losses from the high pressure steam system in every way. If necessary, the auxiliary steam system can also be supplied from the 1200-lb. system through reducing valves, two lines being provided, one to the U.G.I. side and one to the A.G.&E. side. These lines connect directly with the 1200-lb. steam manifolds.

Makeup is supplied from two bent tube type, single effect evaporators, each with 170 sq. ft. of heating surface. These deliver vapor directly to the deaerators which serve as condensers.

Steam for heating the feedwater is obtained by bleeding the low-pressure turbines at the 6th, 10th and 15th stages. The crossover heater, in which the water is given the final heating before it is delivered to the boilers, uses steam from the high-pressure turbine exhaust, as may be seen from the accompanying heat balance diagram. The stage heaters are all of the vertical

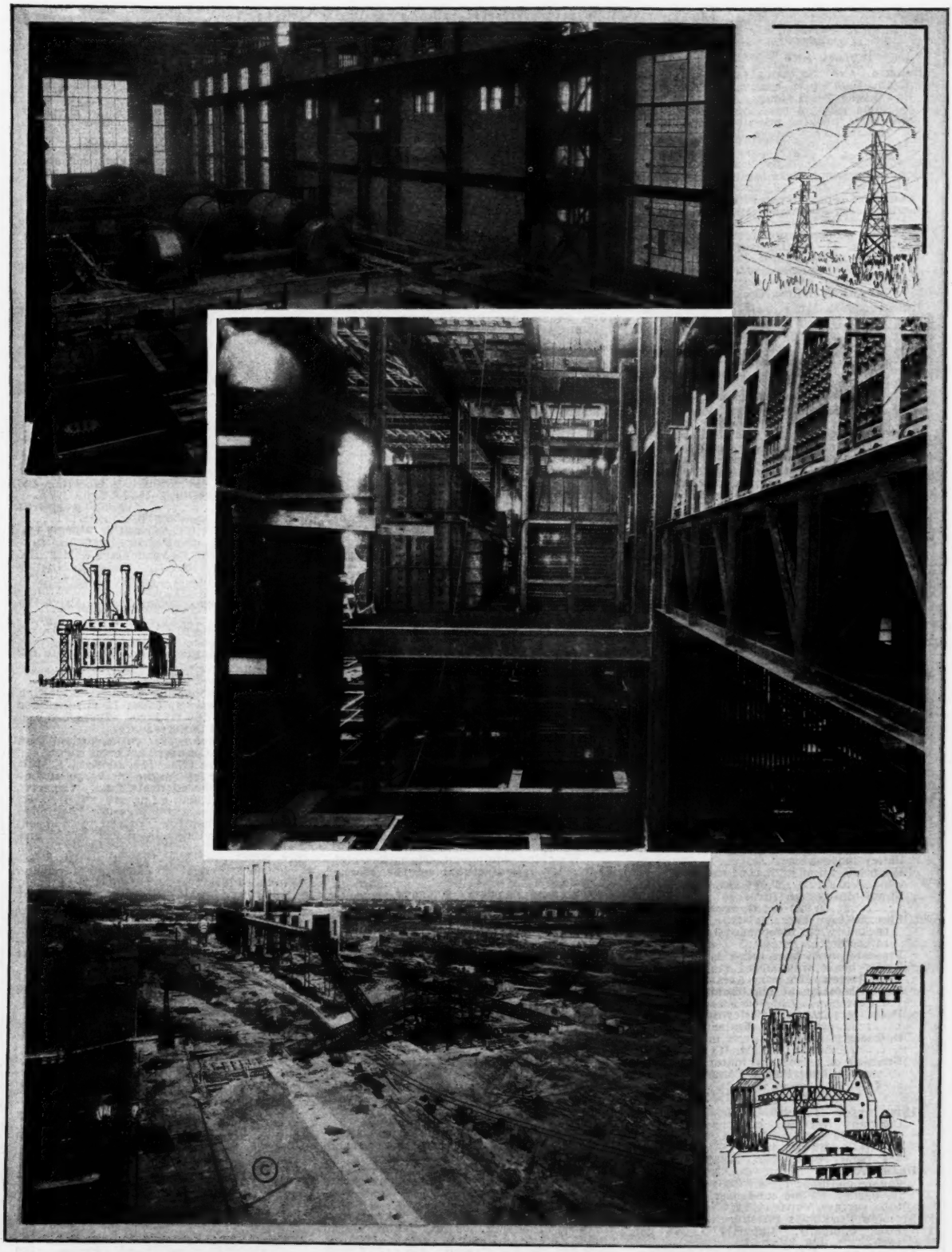


FIG. 7. VIEWS TAKEN OF DEEPWATER STATION DURING CONSTRUCTION. A. THE TURBINE ROOM, SHOWING THE DUPONT EVAPORATORS IN THE CENTER. B. BOILERS, ECONOMIZERS AND AIR PREHEATERS BEING INSTALLED. C. AN EXTERIOR VIEW SHOWING THE STATION AND SURROUNDING PROPERTY. NOTE TOP OF CONCRETE COAL TUNNEL IN FOREGROUND

Principal Equipment, Deepwater Station

Boilers and Economizers

Boilers and Superheaters: 6 cross drum, 9000 sq. ft. heating surface; 3¼-in. tubes; 20 ft. long, single pass. 53 sections wide; 8 rows high. Maximum allowable working pressure—1400 lb.
Superheater: return bend convection type for 725 deg. F.
Babcock & Wilcox Co.

Economizers: 4 steaming economizers on standard boilers 18,326 sq. ft. heating surface; 2 in. diameter tubes. 28 rows wide; 50 rows high. Maximum allowable working pressure, 1400 lb.
Two economizers on reheat boilers. 4,765 sq. ft. heating surface; 26 rows wide, 14 rows high.
Maximum allowable working pressure 1400 lb.
Babcock & Wilcox Co.

Reheaters: 2 reheaters for 450 lb. pressure. 25,155 sq. ft. heating surface; 2-in. tubes, 32 rows wide, 60 tubes high.
Babcock & Wilcox Co.

Safety and Relief Valves:
On boiler .....5-3½ in.
On superheaters .....2-3½ in.
On standard economizers ....2-2 in.
On steaming economizers .....None
Consolidated Ashcroft Hancock Co.

Blowoff Valves:
Boiler .....2 sets 2-in. tandem valves
Steaming economizer .....
..... 2 sets 2-in. tandem valves
Standard Economizer .....
..... 2 sets 2-in. tandem valves
Babcock & Wilcox Co.

Water Columns: 2 per boiler with flat glass gages, manufactured by Babcock & Wilcox Co.

Boiler Valves:
4-in. boiler stop and check valves, Edward Valve & Mfg. Co.
6-in. economizer stop and check valves, Edward Valve & Mfg. Co.
8-in. non-return valves, motor operated, Schutte & Koerting Co.
Motor control—Limitorque Company.

Soot Blowers:
Six boilers, 14 elements each boiler.
Four economizers, 20 elements each economizer.
Two reheaters, 15 element each reheater.
One air heater, 24 elements for air heater.
Diamond Power Specialty Co.

Feedwater Regulators:
Six feedwater regulators..Swartwout Co.
Six differential valves....Swartwout Co.

Furnaces: Three direct fired furnaces, 19,080 cu. ft. furnace volume, flat bottom slagging type, bare tube backed, with independently supported refractory wall.
Projected bare tube area....1781 sq. ft.
Bailey block area.....721 sq. ft.
Heat liberation at maximum rating..
.....22,640 B.t.u.-cu. ft.-hr.
Three bin system furnaces.....
.....19,080 cu. ft. furnace volume
Flat bottom slagging type, bare tube backed with independently supported refractory.
Projected area bare tubes...1797 sq. ft.
Bailey block area..... 342 sq. ft.
Unprotected refractory area. 264 sq. ft.
Heat liberation at maximum rating..
.....22,640 B.t.u.-cu. ft.-hr.
Pressure parts and Bailey blocks....
.....Fuller Lehigh Co.
Refractory wall and arch material...
.....M. H. Detrick Co.
Erection of refractory material.....
.....National Power Construction Co.

Feedwater System

15th Stage Heater: 2 Griscom-Russell Company vertical, condenser type, 2 pass, 1850 sq. ft. of ⅝-in. O.D. No. 18 B.W.G. Admiralty tubes.
Capacity .....332,000 lb.-hr.

Deaerator: 2 Elliott Co., open heater, double chamber type. Capacity 400,000 lb. per hr. Vent condenser, 170 sq. ft. tube surface, capacity 12,400 lb. per hr.

Storage Tanks: 4 Pittsburgh-Des Moines Steel Company. Capacity 15,375 gal. each.

Evaporator: 2 Griscom-Russell Company bent tube type, single effect, supplying make-up water, 170 sq. ft.

10th Stage Heater: 2 Griscom-Russell Company vertical, condenser type, 2-pass, 1762 sq. ft. ⅝-in. O.D. No. 16 B.W.G. Admiralty tubes. Capacity, 437,000 lb. per hr.

6th Stage Heater: 2 Griscom-Russell Company vertical, condenser type, 2-pass, 1970 sq. ft. ⅝-in. O.D. No. 16 B.W.G. Admiralty tubes. Capacity, 437,000 lb. per hr.

Cross-Over Heater: 2 Griscom-Russell Company vertical, condenser type, 2-pass, 2165 sq. ft. ⅝-in. O.D. No. 16 B.W.G. Admiralty tubes. Capacity, 437,000 lb. per hr.

Tank Pumps: 4 Cameron Steam Pump Works. 6-in., six-stage centrifugal pumps. Capacity (each), 650,000 lb. per hr. at 210 deg. F.; discharge pressure, 670 lb. gage. Driven by 750-hp., 1450-1800-r.p.m. Westinghouse motors.

Boiler Feed Pumps: 6 Cameron Steam Pump Works. 8-in., five-stage centrifugal pumps. Capacity (each), 650,000 lb. per hr. at 460 deg. F.; discharge pressure, 1550 lb. gage. Driven by 1250-hp., 3600-r.p.m. Westinghouse motors.

15th Stage Drip Pump: 2 Worthington Pump & Machinery Corp. 1½-in., two-stage centrifugal pumps. Capacity, 44,000 lb. per hr., at 161 deg. F. Driven by 5-hp., 1800-r.p.m. Westinghouse motors.

Cross-Over Heater Drip Pump: 2 Cameron Steam Pump Works, 3-in., four-stage centrifugal pumps. Capacity (each), 65,000 lb. per hr. at 450 deg. F. Driven by 60-hp., 3600-r.p.m. Westinghouse motors.

Coal Storage and Handling

Coal Handling Equipment:
Capacity of initial installation.....
.....300 t. per hr.
Arranged for ultimate capacity of...
.....600 t. per hr.
Electrically operated unloading towers for receipt of water shipment.
Grab bucket, 2-t. capacity, 300 t. per hr., furnished by Mead-Morrison Mfg. Co.
Screening and crushing: 1 Bradford Breaker, 12 ft. 0 in. diameter, 19 ft. 0 in. long to screen coal to pass a 1½-in. diameter opening, capacity, 300 t. per hr.
One hammer mill type of crusher to crush coal to pass ½-in. screen at rate of 300 t. per hr., manufactured by Pennsylvania Crusher Co.
Coal conveying from crusher plant to bunkers, 36-in. conveying belts; capacity, 300 t. per hr.
Conveying belts from storage to crushers handling run-of-mine coal, 42-in. conveying belts; capacity, 600 t. per hr., manufactured and furnished by the Robins Conveying Belt Co.
Railroad shipment, double track pit hopper; capacity, 300 t. per hr.; furnished by the Robins Conveying Belt Co.
Weighing equipment, Merrick weightometer manufactured by the Merrick Scale Co.
Storage capacity, 60,000 t., use 4-t. drag line conveyor; capacity, 300 t. to 600 t. per hr. Equipment manufactured by the Sauerman Bros., Inc.

Special Equipment for Dupont

Evaporators: 7 shells, 108-in. inside diameter, approximately 24 ft. long. Maximum allowable working pressure, 222 lb. gage pressure. Heating surface, 4430 sq. ft., 1-in. O.D. No. 16 B.W.G. Admiralty tubes, 20 ft. long for 450 lb. sq. in. gage pressure.
Griscom-Russell Co.

Seven Evaporator Drip Pumps: Capacity, 108,000 lb. water per hr., 760 ft. total head, to operate with maximum suction pressure of 450 lb. gage pressure, with water at 430 deg. F. Driven by 100-hp. Westinghouse 3600-r.p.m. motor.
Cameron Steam Pump Works.

Two Steam Superheaters: Each capable of superheating 200,000 lb. per hr. of steam 98 per cent dry at 198 lb. per sq. in. absolute to a total temperature of 440 deg. F. when supplied with steam at 1200 lb. per sq. in. gage pressure and 725 deg. F. total temperature. Diameter, 30 in., inside length 14 ft. 6 in. Heating surface, 1250 sq. ft. in ¾ in. diameter No. 14 B.W.G. steel tubes.
Foster Wheeler Corp.

Two Evaporator Feed Pumps: Capacity, 1070 g.p.m., 669 ft. total head, with water at 180 deg. F. driven by 250-hp., 1800-r.p.m. Westinghouse motors.
Turbine Equipment Co.

One Gland Steam Condenser: 735 sq. ft. heating surface, 1 in. diameter, No. 16 B.W.G. Admiralty tubes.
Griscom-Russell Co.

One Water Storage Tank: Elevated 50,000 gal. capacity insulated for 180 deg. F.
Chicago Bridge & Iron Works.

Two High Pressure Traps: For steam superheater; capacity, 30,000 lb. water per hr.; operating pressure, 1250 lb.
Cochrane Corp.

Piping

Piping:
Up to 1350 lb.....Benj. F. Shaw Co.

Fittings:
Up to 1350 lb.....Crane Co.

Valves:
Gates, up to 1350 lb.....
.....The Chapman Mfg. Co.
Globes, up to 1350 lb.....
.....The Lunkenheimer Co.
Checks, up to 1350 lb.....
.....The Lunkenheimer Co.
Checks, up to 300 lb.....Crane Co.
Globes, forged steel, 400 lb. to 1350 lb. .....Henry Vogt Machine Co.
Checks, forged steel, 400 lb. to 1350 lb.....Henry Vogt. Machine Co.
Reducing, 1350 lb. to 450 lb.....
.....Smoot Engineering Co.
Reducing, 1350 lb. to 195 lb.....
.....Spence Engineering Co.
Bleeder check, 600 lb.....
.....Schutte & Koerting Co.
Bleeder check, 125 lb.....
.....Atwood & Morrill
Evaporator blow-off, 250 lb.....
.....Yarnall & Waring Co.
Drum head stop checks, 250 lb. to 1350 lb..The Edward Valve & Mfg. Co.
Altitude, 125 lb.....Kieley & Mueller
Float, 125 lb.....Fisher Governor Co.
Relief and safety, 125 lb. to 1350 lb.
.....Crosby Steam Gage & Valve Co.

Strainers:
Water lines, 125 lb.....Elliott Co.

Valve Control:
...Cutler-Hammer, Inc., Limitorque Co.

Draft System

Three self-supporting steel stacks, each 15 ft. diameter at base; 12 ft. diameter at top, and 100 ft. high. Furnished and erected by Connery & Co.

Duct Work and Flues furnished and erected by Connery & Co.

Six Sturtevant No. 110, design 5, full housing vertical down discharge turbovane type forced draft fans. Capacity of each, 75,000 c.f.m. at 80 deg. F., against 10-in. water pressure. Equipped with vane control. Driven by 2-speed, 200-hp., Westinghouse motor at 900 and 1200 r.p.m.

Six Sturtevant No. 1008 type I.D., full housing vertical up discharge turbovane induced draft fans. Capacity of each, 150,000 c.f.m. at 325 deg. F., against 13 in. negative water pressure. Equipped with vane control. Driven by 2-speed, 550-hp., Westinghouse motors, those on standard boilers operating at 450 and 900 r.p.m.; those on reheat boilers at 600 and 900 r.p.m.

Four Foster Wheeler plate type sectional air preheaters, each containing 46,600 sq. ft. of surface. Used with "standard" boilers.

Two similar preheaters each containing 52,800 sq. ft. of surface. Used with "reheat" boilers.

Service Equipment

Cooler Pumps: 4 Worthington Pump & Machinery Corp. 10-in., single-stage centrifugal pumps, 2500-g.p.m. capacity (each), driven by 50-hp., 1800-r.p.m. Westinghouse motors. Used for oil and air coolers on station units.

Dupont Cooler Pumps: 2 Worthington Pump & Machinery Corp. 5-in., single-stage centrifugal pumps, 1000 g.p.m. capacity (each) driven by 20-hp., 1800-r.p.m. Westinghouse motors. Used for oil and air coolers on Dupont unit.

Sump Pump: 2 Goulds Pumps, Inc. 3-in., single-stage centrifugal pumps, 200 g.p.m. capacity (each) driven by 3-hp., 1800-r.p.m. General Electric Co. motor.

Gland Seal Pumps: 4 Worthington Pump & Machinery Corp. 3-in., single-stage centrifugal pumps, 250 g.p.m. capacity (each), driven by 15-hp., 1800-r.p.m. Westinghouse motor.

GLAND SEAL STORAGE TANKS: 2 Pittsburgh-Des Moines Steel Co. Capacity (each), 15,375 gal.

DEEP WELL PUMPS: 3 Layne-New York Co. turbine type, capacity (each), 600 g.p.m. against 55 lb. discharge, driven by 50-hp., 1800-r.p.m. Westinghouse motor.

ELEVATED TANK: 1 Chicago Bridge & Iron Works. Capacity, 100,000 gal.

FIRE PUMP: 1 Dayton Dowd Co. 10-in., single-stage centrifugal pump, 1500 g.p.m. capacity against 100 lb. gage. Driven by 150-hp., 1800-r.p.m. Westinghouse motor.

AIR COMPRESSORS: 2 Ingersoll-Rand Co. cross-compound type with intercooler, each delivering 722 cu. ft. free air per minute at 125 lb. Driven by 175-hp., 277-r.p.m. synchronous motor.

TURBINE ROOM CRANE:
Span .....72 ft. 6 in.
Main hook.....100 t. capacity
Auxiliary hook..... 25 t. capacity
Niles Crane Corp.

TURBINE OIL SYSTEM:
Five 30 g.p.h. turbine oil separators, motor driven, with tandem rotary gear pump and clear oil collecting tank.
Turbine Equipment Co.
Five oil sludging tanks.
Turbine Equipment Co.
One 350 g.p.h. portable turbine oil separator, motor driven, with electric oil heater, tandem rotary gear pumps and clean oil tank.
Turbine Equipment Co.
Two 50 g.p.m. turbine oil gear pumps, motor driven.
Turbine Equipment Co.
One No. 4 type "C" oil filter, with normal capacity of 5 g.p.m.
S. F. Bowser & Co.

INSTRUMENTS:
Recording thermometers .....Leeds & Northrup Co.
Recording pressure gages....Foxboro Co.
Indicating thermometers .....Tagliabue Mfg. Co.
Indicating pressure gages.....Crosby Steam Gage & Valve Co. ...Consolidated-Ashcroft-Hancock Co.
Steam flow meters.....Bailey Meter Co.
Venturi meters...Builders Iron Foundry
Liquid level indicators.Bailey Meter Co.
Draft gages .....(Hayes) Paul B. Huyette Co.
Flow indicators..New Jersey Meter Co.
Temperature controllers .....Wilson-Moeulen Co.
Condensate conductivity recorders... .....Leeds & Northrup Co.

BOILER ROOM CONTROL:
Combustion control regulating forced and induced draft fans, burner feeders for bin system boilers, mill feeders for unit mill system, variable speed unit mills, and reheat steam temperature.
Boiler feed pressure control regulating tank pump speed and storage tank water level.
Emergency reducing pressure valve control for steam supply to Dupont evaporators from 1200 lb. manifolds.
Smoot Engineering Corp.

PULVERIZED FUEL EQUIPMENT

BIN SYSTEM

(Furnished by Combustion Engineering Corp.)

Three 6-roller Raymond pulverizers with nominal capacity of 15 t. per hr., operated by 200-hp. Westinghouse 450-r.p.m. motors.
Three No. 14 exhausters driven by Westinghouse 125-hp., 1200-r.p.m. motors.
Three 9 ft. 0 in. diameter collectors.
Three rotary air locks driven by 1-hp., 1200-r.p.m. motors.
Eighteen type "R" feeders, size 7500 lb., driven by 18 Westinghouse 2-hp., 500-2000-r.p.m. variable speed motors.
Three primary air fans, each having capacity of 20,000 c.f.m. at 10 in. static pressure, driven by 60-hp. Westinghouse 900-r.p.m. motors.
Three vent fans, each having capacity of 15,000 c.f.m., driven by 30-hp. Westinghouse, 900-r.p.m. motors.
One 14-in. screw conveyor, 140 ft. long, driven by 25-hp. Westinghouse, 900-r.p.m. motor.
Eighteen type "C" size 30 in. pulverized coal burners.
Twelve Richardson automatic weighing and recording scales, each scale having a weigh hopper capacity of 400 lb. and an hourly capacity of 30,000 lb. bituminous coal, crushed to 1¼-in. size. ½-hp. Emerson a.c. motor furnished with each scale.
Furnished by Richardson Scale Co.

UNIT SYSTEM

Three No. 38 Table Type "B" Lehigh pulverizers, each having capacity to pulverize 20,000 lb. per hr. to pass 70 per cent through 200 mesh; driven by 150-hp. Westinghouse constant speed 720-r.p.m. motors.
Three No. 54 Pusher Type Lehigh pulverizers, having same capacity as Type "B" mill, driven by Westinghouse variable speed 150-hp., 360-720-r.p.m. motor.
Twelve pulverizer feeders, drag chain type, each driven by 3-hp. Westinghouse 600-1800-r.p.m. variable speed motors.
Fuller Lehigh Co.
Six exhausters, one for each mill, driven by 60-hp. Westinghouse 1200-r.p.m. motor.
Fuller Lehigh Co.
Twelve cross tube type burners, each having a maximum capacity of 10,000 lb. of coal per hr.
Fuller Lehigh Co.
Six 12-in. diameter drum type magnetic separators wound for 250 v. d.c.
Furnished by The Magnetic Mfg. Co.
Six 12-in. diameter belt type magnetic separators, wound for 250 v. d.c.
Furnished by The Magnetic Mfg. Co.

ASH HANDLING SYSTEM

Two 6-in., 4-stage ash sluicing pumps. Capacity, 1500 g.p.m.; discharge pressure, 250 lb. per sq. in. Total dynamic head, 595 ft.
Furnished by Worthington Pump & Machinery Corp.
Driven by 350-hp. Westinghouse 1800-r.p.m. constant speed motors.
Slag handling equipment for six boilers consisting of 12 cast iron disintegrating chambers with water jets and wearing plates; 12 6-in. Coghlan ash ejectors with Venturi castings; 12 6-in. isolating valves and operating gears; necessary 8-in. white iron pipe to convey granulated material to outside of building.
Furnished by Allen-Sherman-Hoff Co.

TURBINE AND CONDENSING EQUIPMENT

MAIN GENERATING UNITS:
General Electric Co.
Two cross-compound bleeder type, condensing, each unit having a total rated capacity of 53,000 kw. (62,350 kv-a., 85 per cent p.f.) and consisting of 1 high-pressure and 1 low-pressure elements.

HIGH-PRESSURE ELEMENTS:
Steam conditions: 1200 lb. gage, 156 deg. F. superheat, 725 deg. F. total temperature.
Exhaust pressure: 400 lb. gage maximum.
Rated: 12,500 kw., 15,625 kv-a., 80 per cent p.f., 3600 r.p.m., 11,000 v.
Operated at: 11,000 kw., 14,666 kv-a., 75 per cent p.f.
Exciters: 1 60-kw., 3600-r.p.m., 250-v., directed connected.
Air coolers: 1 surface type, 8700 sq. ft. raw cooling water.
Oil coolers: 2 raw cooling water.
Auxiliary oil pump: 1 steam driven.
Ventilating fans: Integral with generator.

LOW-PRESSURE ELEMENTS:
Steam conditions: 388 lb. gage max., 750 deg. F. total maximum steam temperature.
Exhaust pressure: 1.0-in. mercury absolute.
Rated: 50,000 kw., 52,630 kv-a., 95 per cent p.f., 1800 r.p.m., 11,000 v.
Operated at: 42,000 kw., 47,727 kv-a., 88 per cent p.f.
Exciters: 1 4-kw., 1800-r.p.m., 250-v., direct-connected sub-exciter.
Air coolers: 1 surface type, 21,750 sq. ft. raw cooling water.
Oil coolers: 2 raw cooling water.
Auxiliary oil pump: 1 steam driven.
Ventilating fans: 4 direct-connected air blowers, each driven by a 75-hp., 1200-r.p.m., 550-v., 3-phase, 60-cycle motor. Total capacity of 4 blowers, 85,000 c.f.m.
1 single cylinder, non-bleeding, non-condensing, rated 12,500 kw., 15,625 kv-a., 80 per cent p.f., 3600 r.p.m., 11,000 v.
Steam conditions: 1200 lb. gage, 156 deg. F. superheat, 725 deg. F. total temperature.
Exhaust pressure: 200-400 lb. gage.
Exciter: 1 60-kw., 3600-r.p.m., 250-v., direct connected.
Air cooler: 1 surface type, 8700 sq. ft., raw cooling water.
Oil coolers: 2 raw cooling water.
Auxiliary oil pump: 1 steam driven.
Ventilating fans: 1 integral with generator.

CONDENSING EQUIPMENT:
Foster Wheeler Corp.
Two surface condensing equipments for 2 53,000-kw., cross-compound turbo-generator units.
Condenser: 156 in. diameter, cylindrical, double steam belted, iron shell surface condensate having 42,500 sq. ft. of effective condensing surface made up of 7735 ⅞-in. O.D., No. 18 B.W.G. Admiralty metal tubes, 24 ft. 0 in. between tube sheets, and 24 ft. 2½ in. overall length. Tubes expanded into each tube sheet and 1 water box of floating design. Hotwell of cylindrical baffle type with capacity of 100 cu. ft.
Air Pump: 1 size triple "B" Wheeler multi-nozzle three stage steam jet air pump of the surface, inter and after condenser type for each condenser.
Condensate pumps: 2 pumps for each condenser, 6 in. discharge, 10 in. suction, Wheeler type "NS" bronze fitted two stage centrifugal pumps, each having a capacity of 900 g.p.m. at 120 ft., and direct connected to a 50-hp., constant speed, 1200-r.p.m., 550-v., 3-phase, 60-cycle Westinghouse motor.
Circulating pumps: 2 pumps for each condenser, 36-in. discharge, 42-in. suction, Wheeler centrifugal pumps, each having a capacity of 35,500 g.p.m. at 16.0 ft. and direct-connected to a Westinghouse 200-hp., 240/180-r.p.m., 2300-v., 3-phase, 60-cycle motor.
Turbine expansion joint: 2—16 ft. by 8 ft. 6 in. Phillips expansion joint, between turbine and condenser.
Vacuum trippers: 2 vacuum trippers, one for each 53,000 kw. unit. 2—30-in. breakable diaphragms, one for each low-pressure turbine casing.
Consolidated Engine Stop Co:
Intake gates: 54 in. by 54 in.—Caldwell Wilcox Co.
Traveling screens: Chain Belt Co. Capacity, each 30,000 g.p.m. Motor, 5 hp., 1200 r.p.m., 550-v. 3-phase, 60-cycle Westinghouse.
Intake and discharge piping: 54-in. lock-bar steel pipe. East Jersey Pipe Co.
Venturi meters: Simplex Valve & Meter Co. 1—55⅛ in. by 26 in. Venturi tube, complete with mercury manometer in each discharge line.
Control and relay switchboards..... .....Westinghouse Elec. & Mfg. Co.
Motors...Westinghouse Elec. & Mfg. Co.
Auxiliary circuit breakers—2300 v... .....Westinghouse Elec. & Mfg. Co.
Auxiliary circuit breakers—500 v.... .....I. T. E. Circuit Breaker Co.
Circuit breaker compartments—2300 v. .....Alberene Stone Co.
Storage batteries .....Philadelphia Storage Battery Co.
Power cables .....Safety Insulated & Wire Cable Co.
Control cables—armored in building. ...Safety Insulated & Wire Cable Co.
Control cables—armored outside building..Standard Underground Cable Co.
Control cables—braided and leaded... ....Rome Insulated Wire & Cable Co.
Inter-office telephone equipment..... .....Automatic Electric Co.
Turbine room signal equipment..... .....General Electric Co.
Load indicators..Electric Indicator Corp.
Main transformer banks—67,500 kv-a. .....Westinghouse Elec. & Mfg. Co.
Auxiliary transformer bank — 6000 kv-a.....General Electric Co.
Tie transformer bank—66/132-33 kv., 15,000 kv-a.....General Electric Co.
Auxiliary tie transformer bank—66-11/2.3 kv.....General Electric Co.
Circuit breakers—132 kv..... .....General Electric Co.
Circuit breakers—33 kv..... .....General Electric Co.
Circuit breakers—66 kv..... .....G. E. Co. and W. E. M. Co.
Circuit breakers—11 kv..... .....General Electric Co.
Lightning arresters.General Electric Co.
Disconnecting switches ....Delta Star Electric Co.
Carrier current coupling..... .....Ohio Brass Co. and G. E. Co.
Steel structures....R. D. Coombs & Co.

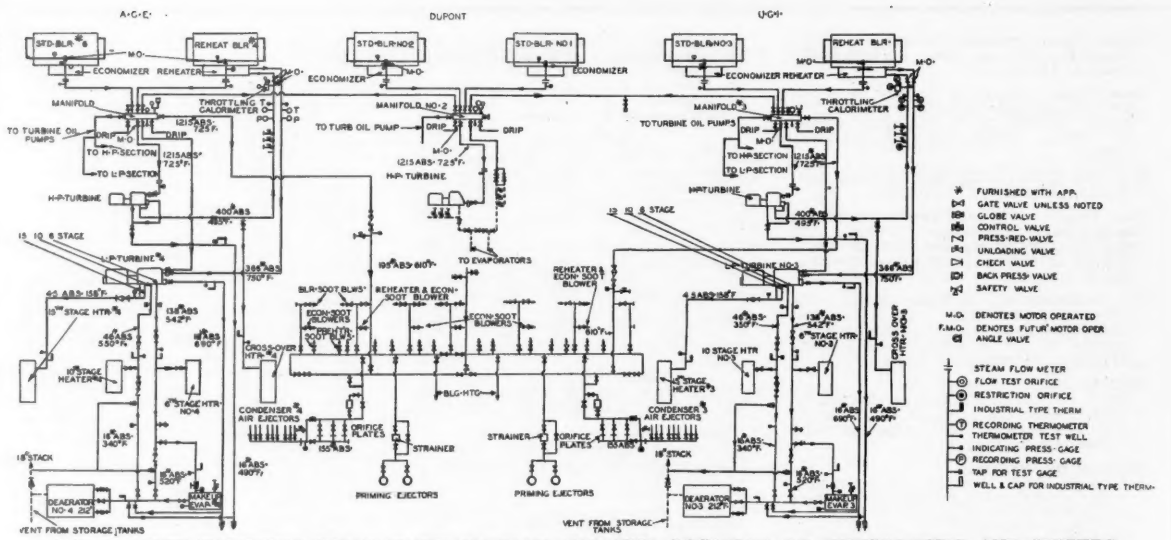


FIG. 8. HIGH PRESSURE STEAM FLOW DIAGRAM, SHOWING LOCATION OF INSTRUMENTS AND METERS

condenser, 2-pass type with 5/8-in. No. 16 B.W.G. Admiralty tubes and with capacities of 437,000 lb. per hr. except the 15th stage heater, which is rated at 332,000 lb. per hr.

Turbine Generators

The arrangement of the generating units is indicated in Fig. 2, the American Gas and Electric unit being located at the south end of the station, the United Gas Improvement unit at the north end and the Dupont unit in the middle. The units are all mounted upon heavy concrete foundations, this form being deemed preferable to steel because of the greater mass and consequent freedom from vibration.

Each of the two main units consists of an 11,000-kw. high-pressure element operated at 1215 lb. abs. and a 42,000-kw. low-pressure element operating at 388 lb. abs. at full load.

The Dupont turbine units is identical with the high-pressure elements of the cross compound units but is rated at 12,500 kw., 80 per cent power factor. The two high-pressure elements of the cross compound units and the Dupont machine operate at 3600 r.p.m. while the two low-pressure units operate at 1800 r.p.m.

Steam leaves the high-pressure elements at a pressure of about 400 lb. abs. and at a temperature of 495 deg. and is then reheated to 750 deg. before it is delivered to the low-pressure units. The reheaters are designed for a maximum temperature of 775 deg. In order to prevent excessive temperature of the reheat steam, fresh air doors are installed over the preheaters with provision for both manual and automatic control. These fresh air doors provide for the admission of cold air should the turbine, for any reason, trip out. The trip-out mechanism at the same time shuts off the pulverized fuel burners and opens the air admission doors on the reheaters.

As stated previously, the Dupont unit exhausts directly into seven high-pressure evaporators at a pressure varying between 200 and 400 lb. gage. These evaporators are located in the turbine room, some being mounted above the turbine room floor and others below. Each shell is 108 in. in diameter and approximately 24 ft. long. They have 4430 sq. ft. of heating surface and are built for a working pressure of 222 lb. The tubes are built for 450 lb. pressure. These evaporators, at full load, deliver 400,000 lb. of steam per hour to the Dupont works at a pressure of 180 lb. This steam is used in the Dupont manufacturing operations and before leaving the station is superheated to 440 deg. F. total temperature in live steam superheaters. Auxiliary steam for operating the soot blowers, condenser steam jets, etc., is also obtained from these evaporators. The condensate produced by this process steam is returned to the evaporators at a temperature of approximately 180 deg. F.

While this one unit will supply the steam needs of the Dupont Co. at the present time, space has been left for the installation of a second unit, should this ever become necessary.

Condensing Equipment

Each of the two low-pressure turbines is provided with a 42,500-sq. ft. surface condenser, having 7735 7/8-in. No. 18 B.W.G. tubes. The tubes are expanded into each tube sheet and one of the water boxes is of floating design. The hotwells are of the cylindrical baffle type with a capacity of 100 cu. ft. The condenser shells are mounted solidly, expansion being taken care of by Phillips expansion joints between the turbine and the condenser.

Air is removed from these units by multiple nozzle three-stage steam jet air pumps with surface condensers of the inter and after type. There are two condensate pumps for each condenser and also two circulating water pumps.

Circulating water is obtained from the Delaware River. In order to prevent recirculation of the warm discharge from the condensers, tidal changes in the river flow have been called into service. This is accomplished by providing a discharge channel, parallel to the river bank, with a bottom some 10 ft. above that of the intake channel. The intakes are located 18 ft. below mean low water. The discharge channel is open at both ends and as the tide changes and the flow of the river reverses, the end through which the warm water flows back into the river is alternated. As may be

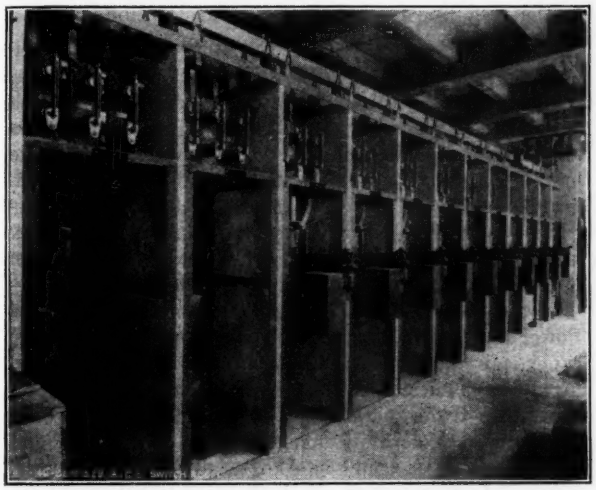


FIG. 9. INTERIOR VIEW IN THE A.G.E. SWITCH ROOM

noted on Fig. 1, the intake crib forms the outer wall of the discharge channel. Two intake and discharge cribs are provided, one for each condenser. Provision has been made for a third, should it ever be desirable to run the Dupont unit condensing.

Electrical Features

The same division of the station equipment into units used by the three participating companies described in connection with the boiler and turbines is adhered to on the electrical side. Each generating unit serves its own electrical system, although provision is made for the interconnection of all the three systems at any time.

Low voltage buses have not been provided, the generators feeding directly through transformers to high tension buses in the outdoor switchyard. The generators are connected directly to the step-up transformers through disconnect switches, no generator circuit breakers being provided on the low tension side of the transformers. All switching, therefore, is done at 66 kv.

As may be noted from the single line electrical diagram, the high and low-pressure generators are solidly tied together, so that the two elements operate as a single unit.

Each of the two main generating units is connected to three 22,500-kv-a., single-phase, 76.2/11-kv. transformers, connected Y — Δ and to one 6000-kv-a., three-phase, 11.5/2.415/.575-kv. transformer. The latter transformers furnish 2300 and 550-v. current for operating the station auxiliaries.

All auxiliaries operate from common buses. Auxiliaries operate either at 2300 or 550 v., all motors less than 125 hp. using 550 v. In addition to the auxiliary power transformers connected to the main units, there is also a similar transformer, which is arranged to take current from the 11-kv. Dupont bus. Auxiliary power can also be supplied through a special transformer connected between the 11-kv. and the 66-kv. systems with a third winding supplying the 2.3-kv. auxiliary bus. In this unit, the 11-kv. winding is connected to the 11-kv. Dupont bus.

The two banks of main transformers which are located immediately outside of the building connect to either of two 66-kv. buses, as shown. These buses are split so that the U.G.I. and the A.G. & E. sections can be operated separately or together as may be desired or

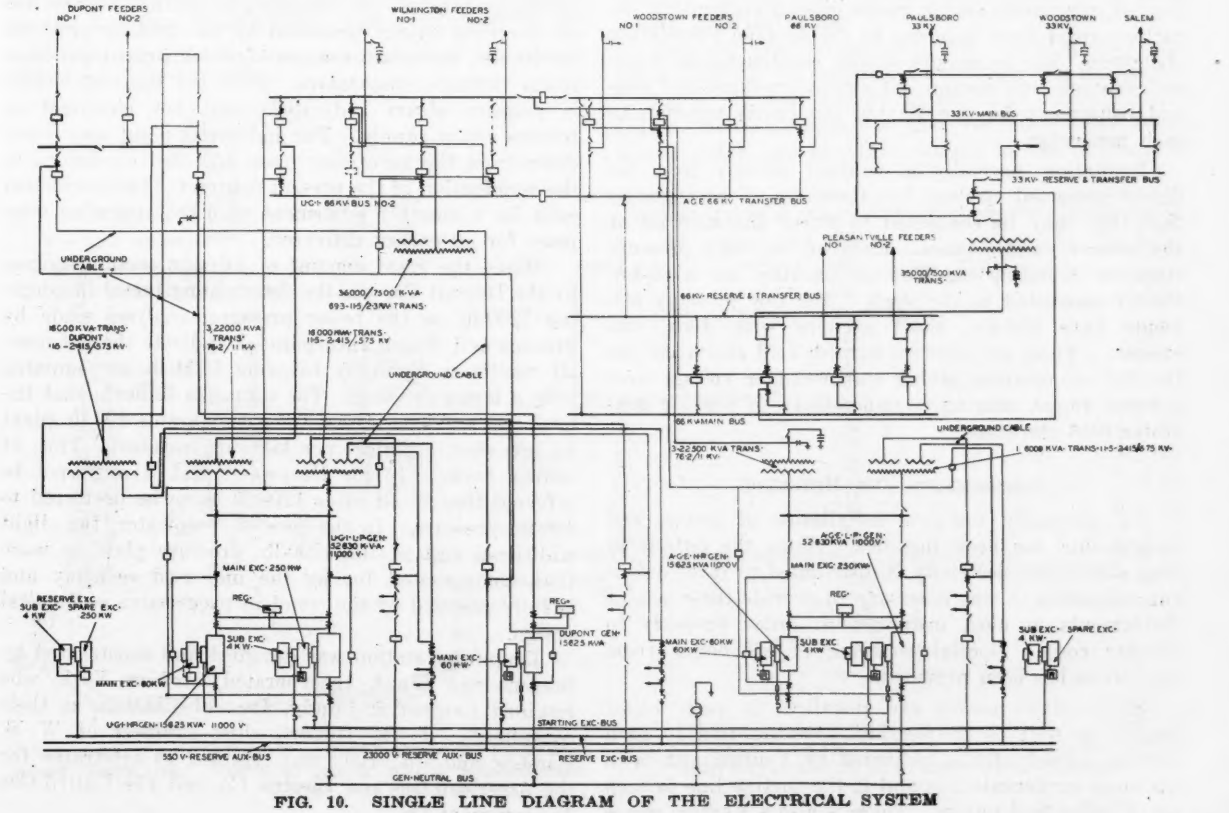

DUPONT FEEDERS NO·1 NO·2
WILMINGTON FEEDERS NO·1 NO·2
WOODSTOWN FEEDERS NO·1 NO·2
PAULSBORO 66 KV
PAULSBORO 33 KV
WOODSTOWN 33 KV
SALEM
33 KV·MAIN BUS
33 KV· RESERVE & TRANSFER BUS
U·G·I· 66 KV· BUS NO·2
A·G·E 66 KV· TRANSFER BUS
PLEASANTVILLE FEEDERS NO·1 NO·2
35000/7500 KVA TRANS·
66 KV· RESERVE & TRANSFER BUS
UNDERGROUND CABLE
36000/7500 K·V·A· 69·3-115/23 KV TRANS·
16500 K·V·A· TRANS· DUPONT 115-2·415/·575 KV·
3-22000 KVA TRANS· 70·2/11 KV·
16000 KVA· TRANS· 115-2·415/·575 KV
UNDERGROUND CABLE
66 K·V·MAIN BUS
UNDERGROUND CABLE
3-22500 KVA TRANS· 76·2/11 KV·
1-6000 KVA· TRANS·115-2·415/·575 KV·
U·G·I·-U·P·GEN· 52830 K·V·A· 11000 V·
A·G·E·-U·P·GEN· 52830 KVA 11000 V·
A·G·E·-N·P·GEN· 15625 KVA 11000 V·
MAIN EXC· 250 KW
MAIN EXC· 230 KW
REG·
RESERVE EXC SUB EXC· 4 KW SPARE EXC· 250 KW
SUB EXC· 4 K·W·
MAIN EXC· 60 K·W·
DUPONT GEN· 15625 KVA
MAIN EXC· 60 KW
MAIN EXC· 60 K·W·
SUB EXC· 4 KW
SUB EXC· 4 K·W·
SPARE EXC· 4 K·W·
U·G·I·-N·P·GEN· 15625 K·V·A· 11000 V·
STARTING EXC· BUS
550 V· RESERVE AUX· BUS
2300 V· RESERVE AUX· BUS
RESERVE EXC· BUS
GEN·NEUTRAL BUS

FIG. 10. SINGLE LINE DIAGRAM OF THE ELECTRICAL SYSTEM

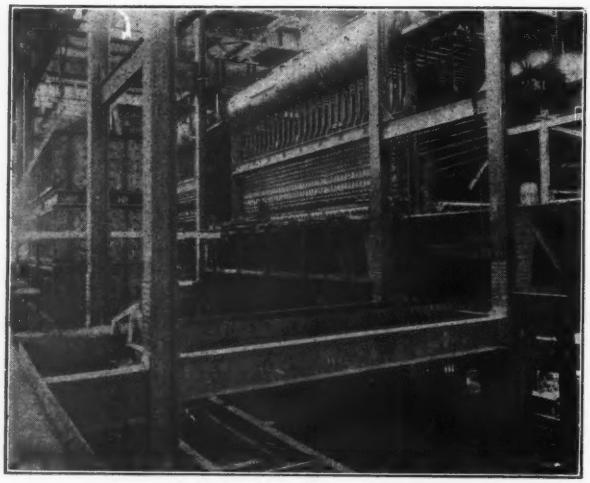


FIG. 11. BOILER ROOM DURING CONSTRUCTION

necessary. These buses on the A.G. & E. side in turn are connected to two other 66-kv. buses which in the future, however, will be operated at 132 kv. These buses, in turn, feed the 33-kv. buses through a bank of three 5000/7500-kv-a., 66/132-34.5-kv. transformers.

All switching is done from the main control room on the third floor of the service building. This room is located at the center of the building and overlooks both the turbine room and the outdoor switchyard.

The generator and feeder panels are of the vertical type. The control panels for the Dupont unit are located on the U.G.I. side of the center line.

Switching equipment for each generating unit is located in separate switch rooms located underneath the turbine room floor adjacent to the turbine foundation structure. The rooms are solidly constructed of brick and concrete and contain all circuit breakers and control equipment for the 2300-v. auxiliaries common to each generator.

Excitation, normally is obtained directly from the direct connected exciters, but these are all arranged so that they may be connected to either the starting or the reserve exciter buses. Each of the high pressure elements including the Dupont machine, has a 60-kw. exciter connected to the shaft. The low pressure elements have 250-kw. shaft exciters with 4-kw. sub exciters. These sub exciters furnish field excitation for the 250-kw. exciters, giving stable exciter voltage over a broad range, making it unnecessary to provide generator field rheostats.

Instruments and Metering

An unusually complete installation of meters and instruments has been installed. Since the output of both steam and electricity is distributed to three different companies, it was necessary to provide three sets of instruments in most instances, in order properly to allocate costs. Special metering of all boiler room auxiliaries has been provided.

Steam flow meters are installed in each boiler header as well as in the high-pressure line to each turbine. Feedwater is measured by Venturi meters in the main condensate line and in the suction line to each set of boiler feed pumps. There is also a Venturi meter in the feed line to each boiler. The location of other meters and instruments is indicated in Fig. 8.

Conclusion

In concluding this description, a few words may be of interest in regard to the relationship existing between the three companies interested. Deepwater is not the first plant to be jointly owned. The Windsor station, near Wheeling, W. Va., is the joint property of the Ohio Power Co. (a subsidiary of the American Gas & Electric Co.), and the West Penn Power Co. Stanton is another station in which the American Gas and Electric Co. has joint ownership with the Pennsylvania Power and Light Co. In both of these earlier stations, experience has demonstrated that it is practical and highly economical for a station to operate for the joint account of two owners. In the case of Deepwater, careful studies made indicated that in addition to joint ownership, steam could be sold to advantage to nearby industrial plants.

Under the present agreements, each of the two owning companies own half of the capital stock of the operating company, that is, of the Delaware River Manufacturing Co. Agreement for management, operation and maintenance as well as existence of the operating company may be dissolved upon two years' notice by either owner. The operating company may not sell power to other parties not covered in the agreement without the joint agreement of the owners. In case of any misunderstanding or dispute between any of the parties concerned, such disputes are to be settled by two arbitrators appointed by the owning companies. The arbitrators select a third.

The Dupont Co. plant purchases service through the billing of steam generation costs, proportional fixed and operating charges, etc., adjusted for equity. It receives all electrical energy produced by the turbine provided for its use, the exhaust steam of which provides process steam through evaporators. Thus the basis of charge is primary steam (adjusted) and not electrical or process steam supply. The industrial plant may withdraw from the agreement upon specified conditions at the termination of the present contract. The agreement calls for a monthly settlement with the operating company for all energy delivered.

While the great amount of exhaust steam required by the Dupont Co. was the determining factor in adopting 1200-lb. as the boiler pressure, analyses made by Stevens and Wood, Incorporated, indicate the net overall results as distinctly favoring 1200 lb. as compared with a lower pressure. The estimates indicate that the total cost will exceed that for a comparable 400 lb. plant by less than 5 dollars per kilowatt installed. This, of course, holds only for Deepwater and it must not be inferred that in all cases 1200 lb. is to be preferred to 400-lb. pressure. In the case of Deepwater, the slight additional cost of the 1200-lb. pressure plant is more than compensated for by the increased economy and is fully justified by the trend in progressive economical design.

Deepwater station was designed and constructed by Stevens and Wood, Incorporated, of New York, who retained Sargent & Lundy, Inc., of Chicago, as their consultants. E. M. Gilbert, chief engineer of W. S. Barstow and Co., Inc., was retained as arbitrator for the American Gas and Electric Co. and The United Gas Improvement Co.

Why Tolerate a Noisy Operating Room?

NOISE THAT LOWERS OPERATOR'S EFFICIENCY CAN BE ELIMINATED, AS DEMONSTRATED AT SAN FRANCISQUITO PLANT NO. 2. BY CLAYTON M. ALLEN*

IN THE DESIGN and construction of the operating room of the San Francisquito Power Plant No. 2 of the Department of Water and Power, City of Los Angeles, sound deadening and absorbing materials and methods were extensively and effectively used in what is believed to be the first application of acoustical treatment in electric power plants. This hydroelectric plant, it will be remembered, was reconstructed from the ground up following its destruction by the overwhelming flood of March 13, 1928.

In the original construction, the machine and building foundations were built as independent structures, a feature of design which made effective acoustical treatment possible. The success of the acoustical treatment was largely due to the thorough study of sources and transmission paths of the disturbing noises and the application of the prescribed treatment.

SOURCES OF NOISE

Main turbine generator units, the source of by far the greater part of the noise, were, by their high speed and inherent design, practically beyond control from the standpoint of reducing noise output. The problem was one of controlling and confining noise so that as little as possible enters the operating room.

On account of the independent foundation feature, the generator room floor was carried on beams connected to the building foundations. The joint between the floor and machine foundation was approximately ¾ in. wide and was filled with a mastic compound, which absorbed much of the noise that otherwise would be conducted through the building frame. Auxiliary equipment was set on mastic joints, thus minimizing the transmission of noise from all sources.

Since the paramount object was to have an ideal operating room, attention was directed to two problems: first, keeping the noise out; second, absorbing what escaped the barriers and entered the room.

To solve the first problem, the walls on the generator room side were constructed with a hollow center using hyrib and plaster, the center space being filled with diatomaceous earth. The windows were of double plate glass of the non-opening type. All doors were metal covered and of heavy construction.

ABSORBING NOISE THAT COULD NOT BE KEPT OUT

The second problem of absorbing noise that entered the operating room and minor noises that originated within the room was easily and satisfactorily solved Various treatments were required as the building was of concrete construction, including all walls of the operating room, except the one described.

On the ceiling, between the beams, a layer of ¾-in. acoustical felt, Johns-Manville Naskote B, was applied and all corners were finished with a neat ¾-in. plain corner wood moulding.

The floor was covered with ¼-in. battleship linoleum, fitted closely to all switchboard channels and base molds.

As a further absorbing medium Johns-Manville 1¼-in. ebony asbestos was used for the control bench board, meter and auxiliary boards in lieu of slate or

*Junior Electrical Engineer, Dept. of Water and Power, City of Los Angeles, Calif.

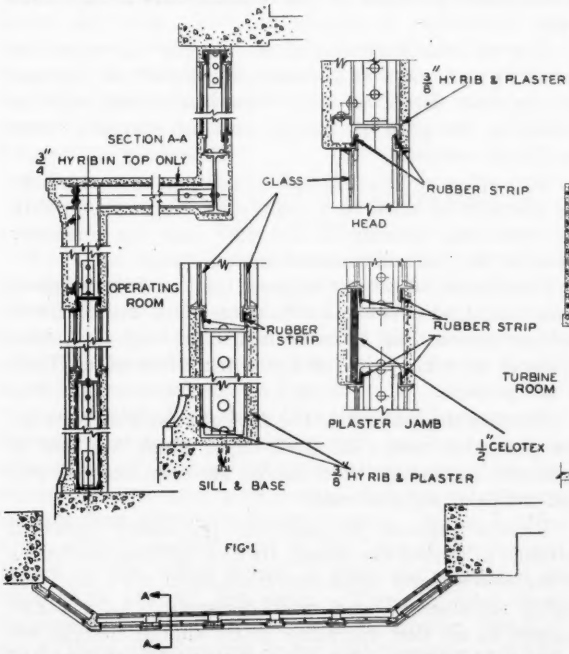


FIG. 1. DETAILS OF WINDOW CONSTRUCTION TO PREVENT NOISE ENTERING CONTROL ROOM FROM GENERATOR ROOM

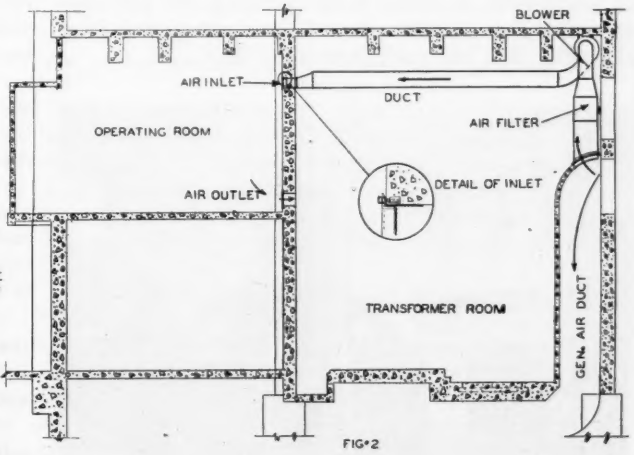


FIG. 2. SINCE CONTROL ROOM WINDOWS ARE FIXED, FILTERED AIR IS SUPPLIED BY A BLOWER

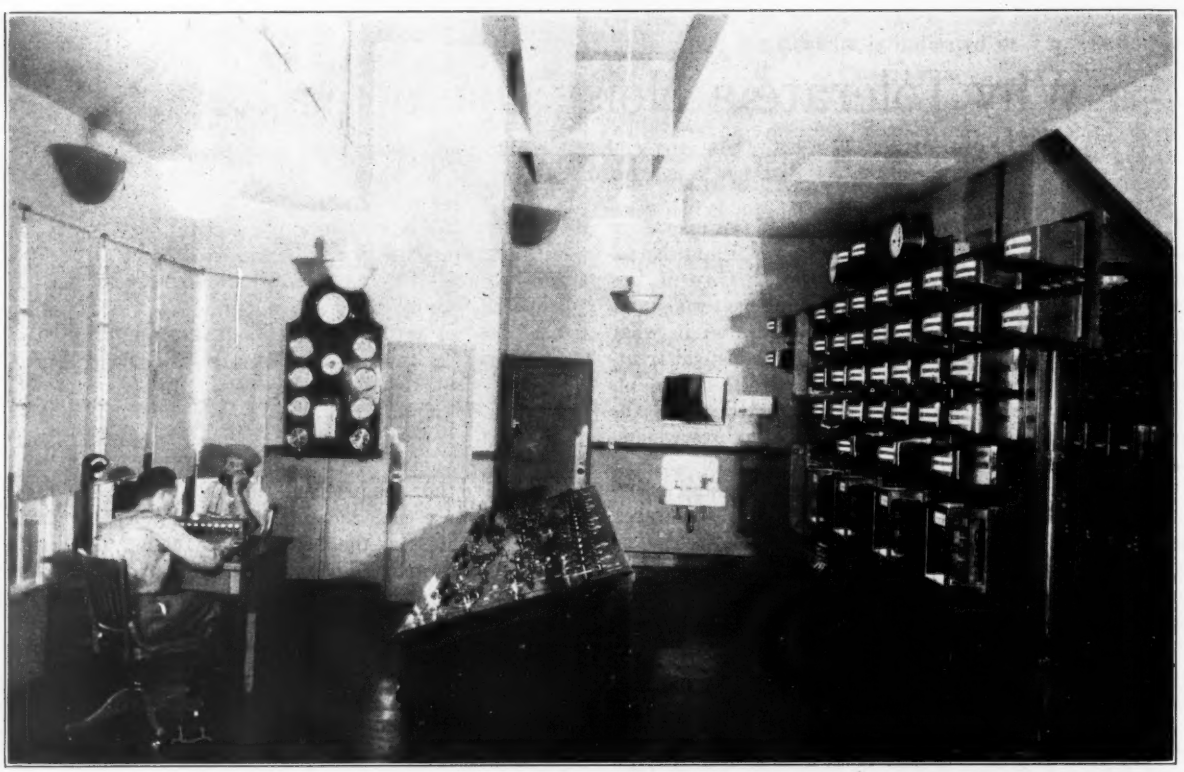


FIG. 3. THE CONTROL ROOM AS IT APPEARS NOW, SHOWING INDIRECT LIGHTING FIXTURES, EBONY ASBESTOS SWITCHBOARDS, ACOUSTICAL FELT ON CEILING, LINOLEUM FLOOR AND AIR INLET

marble boards. The opening in the floor below the bench board was closed off by the use of removable pieces of ¾-in. ebony asbestos.

Ventilation and Lighting

Ideal operating conditions having been produced from the standpoint of sound, it was of vital necessity to take care properly of the ventilating and lighting problems, in order that the acoustical effect would not be jeopardized in actual plant operation and also that operating room conditions would be as nearly ideal from all angles as it was possible to make them.

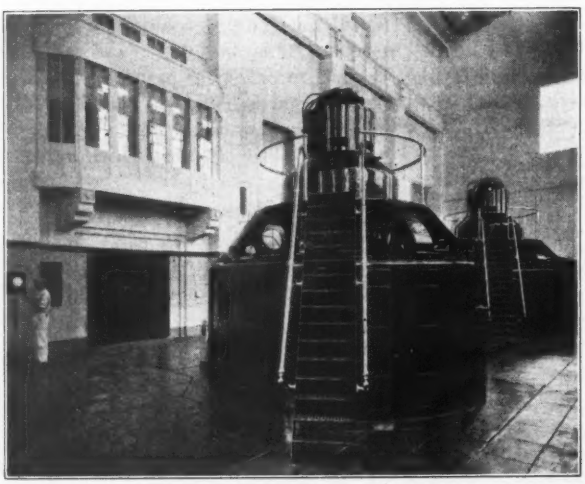


FIG. 4. BAY WINDOW, CONSTRUCTED AS IN FIG. 1, GIVES OPERATORS FULL VIEW OF GENERATOR ROOM

A closed system of ventilation was installed whereby air was taken from the generator air inlet duct and forced by an Ilg No. 25 blower into the operating room on one side near the ceiling. Air is allowed to escape into the transformer room through a floor register set in the lower part but in the opposite side of the same wall.

The air was filtered before entering the room by installing two units of National Air Filter Co. Airmat dry air duct filters, in which wood-pulp mats are installed in the path of the air and are changed when conditions warrant.

This effective filtering and ventilating system allows the operator to work in a completely closed room, with the occasional opening of the door into the generator room as the only objectionable condition.

Installation of totally indirect lighting fixtures gives a good lighting effect and eliminates glare and shadows, making the reading of instruments an easy task, particularly at night when the counter effect of daylight is not present.

Window shades control the daylight entering through the generator room; on dark days, which are few in Southern California, these shades are completely drawn and artificial light is used.

Results obtained in applying the above described methods to control the sound, air and lighting conditions of the above power plant operating room are considered highly satisfactory and most desirable. As a consequence, in all new operating rooms similar designs are being used and, in other present plants on the system, conditions are being improved by the addition of the above controlling features.

Developments in Foreign Boiler Design

ACCORDING TO AN N. E. L. A. REPORT, FOREIGN ENGINEERS APPEAR MORE INTERESTED IN HIGHER TEMPERATURES THAN THEY DO IN HIGHER PRESSURES

AN INTERESTING innovation in foreign boiler design is the Rauber-Babcock boiler shown in Fig. 1. This construction extends to the boiler the use of transverse fins common in economizer construction, to reduce the resistance to heat flow at the contact surface between gases and boiler tubes and make the convection heating surface more effective. Fins of different diameters are welded onto the tube surfaces so as to make the total contact surface in successive rows of tubes approximately inversely proportional to the temperature difference between the gases and the water. Based on the area of the tube surface without the fins, average evaporation rates of over 30 lb. per sq. ft. of steam, or 1000 per cent rating, have been obtained in a small experimental boiler and over 40 lb. per sq. ft. are expected from larger units.

Two 3100-sq. ft. Rauber units are under construction for the Troyes central station. A number of other units, ranging up to 300,000 lb. capacity, 1000 lb. pressure and 930 deg. F. and a small experimental unit for the unusual steam conditions of 2800 lb. pressure and 1100 deg. F. are at present under study.

Another interesting design brought out by the Soc. Anon. des Foyers Automatiques for an industrial power plant in France is shown in Fig. 2. This is an unusually compact design for a capacity of 100,000 lb. per hr. and includes a Woods steam generator with longential firing and air preheater built in two sections separated by the inlet air duct. Both forced and induced draft fans, located beneath and above the air preheater as shown are used. The bin system of pulverized coal firing is used, with the four burners located near the bottom of the furnace, the gases passing upward through the water cooled furnace to the superheater, downward through the convection boiler surface and upward through the preheater.

SUPERHEATED STEAM USED TO TRANSFER HEAT IN NEW DESIGN

European designers are not content to build high-pressure boilers on the same principles as low-pressure boilers and a number of novel designs such as the Benson, Atmos, Loeffler and Schmidt have been brought out. The most recent of these is the Brown-Boveri shown diagrammatically in Fig. 3.

It is typical of all these that they avoid evaporating the water on walls in contact with the fire. Benson heats water, without actual evaporation, at or above the critical pressure and temperature and produces steam by expanding down to a lower pressure. In the Loeffler boiler, steam is superheated by the heat of the fire and carried to the water where it loses its superheat in evaporating part of the water. Three to four times the steam output is circulated as a heat carrier. Schmidt uses a closed water circuit under high pressure as a heat carrier.

Brown-Boveri also employs superheated steam to transfer heat but avoids the circulating blower. The steam circulation is maintained by natural pressure drop through the various stages of evaporation. The original and simple principle of the Brown-Boveri steam generator is illustrated in Fig. 3. In a small exciter boiler, 1, a small percentage of the desired steam output is raised to a pressure somewhat above the delivery

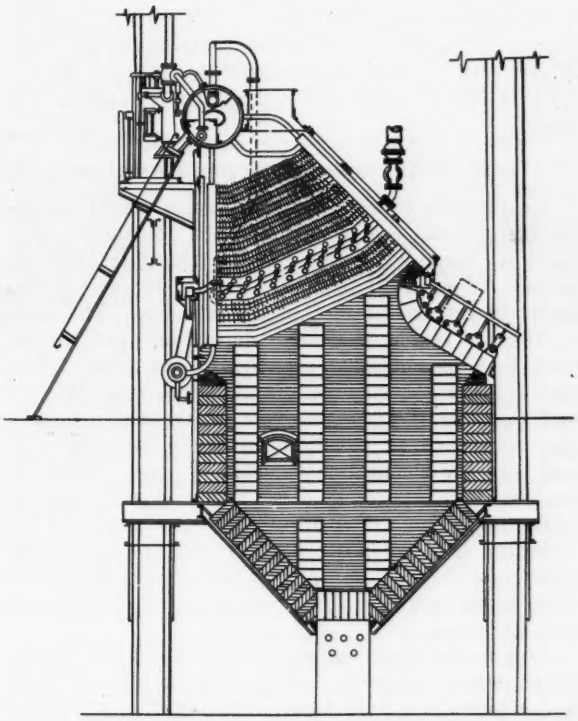


FIG. 1. EXPERIMENTAL RAUBER-BABCOCK FIRE TUBE BOILER

pressure of the boiler. This steam is heated in a first superheater, 2. It then flows through a first evaporator, 3, to which preheated feedwater is supplied from the tank, 15, by the pump, 14, and injected through nozzles. The superheat of the steam serves to evaporate a certain part of the water.

The flow of steam, increased by the newly evaporated water, goes to a second superheat, 4, absorbs a further quantity of heat and carries it to a second evaporator 5, turning a further quantity of feedwater into steam. The volume of steam is again increased, goes to a third superheater, 6, and so on, until, after a number of stages, the desired output of steam is reached; it then flows through a last superheater, 12, to the engines. In flowing through the stages of the boiler, the pressure of the steam will drop somewhat, according to the resistance encountered through the superheaters and evaporators. No energy loss arises from it, however, and the circulating blower is avoided.

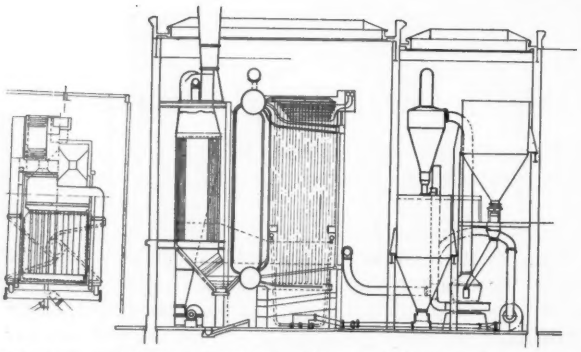


FIG. 2. S. A. FOYERS AUTOMATIQUES WOOD'S TYPE STEAM GENERATING UNIT FOR 100,000 LB. PER HR. CAPACITY

With a pressure of 1500 lb. and a temperature raised in the superheaters to 900 deg. F., and with 500 deg. F. feedwater, the amount of steam is increased by about 40 per cent in each stage; therefore, starting with 5 per cent exciter steam, the full output is reached in 9 stages.

Scale Formation on Surfaces Prevented

Evaporators consist of simple drums placed outside the furnace and are easily accessible. Means are provided for suitably guiding the injected water and the steam. An excess of feedwater may be supplied or the necessary rate maintained by a float valve. The tank, 15, is made larger or smaller, depending upon the desired heat accumulating capacity of the boiler. Preheated feedwater may be supplied from this tank or cold feedwater from a reservoir. This tank acts to a high degree as an equalizer on rapid fluctuations of load. In the combustion chamber, a large portion of the heat is transmitted by direct radiation to the heating surface. The high temperature of the tubes and of the preheated combustion air prevents the fire from being excessively chilled. Large brick settings are done away with, which results in low prices and low starting and standby losses.

Due to the small masses of brick work, the Brown-Boveri steam generator is well suited to take up rapid load changes and peak loads. The water is not heated through contact with a wall. Therefore, incrustation of the heated walls from impure water is impossible. The deposits drop to the bottom of the evaporators, where they are harmless and may be removed by replacing the filter pieces by clean ones.

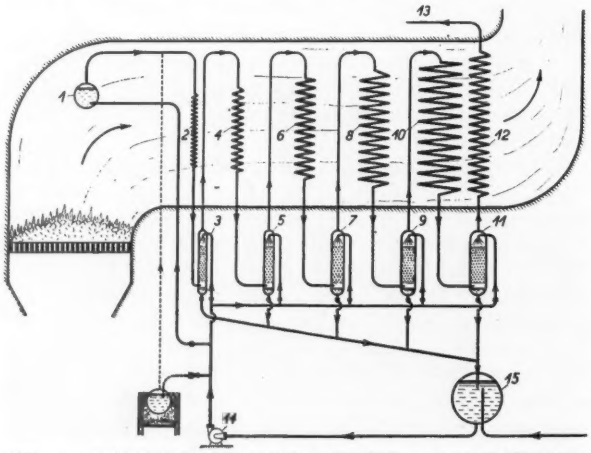


FIG. 3. DIAGRAMMATIC ARRANGEMENT OF THE BROWN BOVERI STEAM GENERATOR

Advantages of the Brown-Boveri stage-boiler are said to be: First, no heat transfer from a wall to the water, insensibility to impure feedwater, no incrustation of the heating surfaces and no priming; second, thin tubes for heating surfaces, light weight of the boiler, rapid adaptation to load changes and low prices; third, light water drums away from the fire, no weakening of the walls with water tubes; fourth, the water level in the drums may be varied to give a large heat storage capacity suitable for peak loads; fifth, small masses of brick work with small heating and standby losses, low first costs and maintenance, boilers suitable for rapidly fluctuating and peak loads; sixth, no high-pressure circulating blower required.

N.E.L.A. Report on Power Station Chemistry, Part II

Power Station Chemistry—Part II, a serial report of the Prime Movers Committee, National Electric Light Association, 420 Lexington Ave., New York City, has just been issued as Publication No. 289-114. This report includes a non-technical review of water treatment for steam generation. The committee has adopted as standard procedure the reporting of water analyses in ionic form and expressed in parts per million by weight. The reactions involved in water treatment calculations are presented in ionic form, and a procedure is included for calculation of water reagent requirements. This presentation departs from previously published methods.

A contributed statement discusses a graphic method of controlling the treatment in a Lime Soda system. The committee publishes an individual member statement on a laboratory study of turbine oil, using a Funk sludging machine.

Approved test methods for judging the quality of turbine oils are presented under Recommended Test Procedures. The tests will serve to establish variations in various shipments of the same trade name of turbine oils, and a selected few will serve in a measure to show the rate of alteration an oil undergoes in service. The tests alone are not suitable for determining the comparative desirability of different brands of new oils for turbine lubricating service.

The report emphasizes the desirability of making tests for the Hydrogen Ion Concentration in water supplies as one of the factors to be considered in the corrosiveness of the water; statements of the significance of the hydrogen ion concentration have been included both as committee and manufacturers statements.

Individual members have submitted statements for plant use, one on the graphical estimation of various alkalinities in water, the other a plant control test for estimating phosphates in boiler water. A manufacturer's statement on equipment for the electrometric determination of hydrogen ion concentration and direct reading of the conductance of water concludes the report.

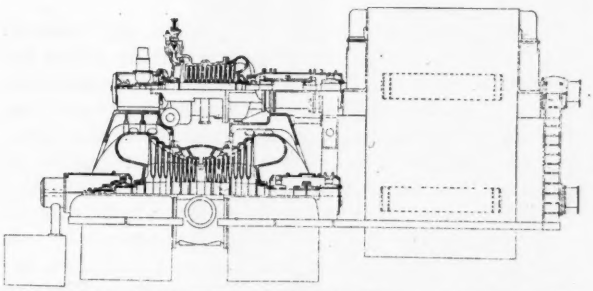
Diesel engines make good standby units because of their quick availability and low standby and operating charges.

Ford to Install 110,000-Kw., 1200-lb. Turbine-Generator

AT THE RIVER ROUGE PLANT, Ford Motor Co. plans to install a new turbine-generator of 110,000-kw. capacity, vertical compound type, taking steam at the throttle at 1200 lb. gage from two steam generating units of 700,000 lb. an hour capacity each.

The new turbine-generator represents interesting departures in design and construction; it is a vertical compound unit and is the first large machine to be made to this design. The high-pressure turbine and generator will be mounted directly on top of the low-pressure turbine and generator, as shown, resulting in the most compact unit yet proposed. Each element has a capacity of 55,000 kw.

One of the important features of the design—of particular value in the Ford plant, where floor space is



CROSS SECTION THROUGH 110,000 KW. 1200 LB. TURBINE GENERATOR FOR FORD CO.

at a premium—is the small amount of space which will be taken up by the new unit. The general dimensions include a length of 57 ft. 5 in., a maximum width of 23 ft. and a little less than 21 ft. overall height from the floor. The approximate weight is 2,000,000 lb. The space to be occupied is less than 0.25 cu. ft. per kilowatt of capacity.

Two older generating units, rated 12,500 kw. each, are to be moved out to make room for the new machine. The superseded turbine-generators were built and installed by the General Electric Co. in 1921, and have given excellent service since installation. Striking evidence of the improved design of the new machine is that, in spite of its tremendously greater output, it will occupy approximately the same floor space in the power plant as did the two older units and produce 110,000 kw. instead of 25,000 kw.

The new machine is designed to use approximately 50 per cent less coal to produce a given number of kilowatt-hours than the units which will be removed and to require less than a pound of coal to generate a kilowatt-hour of electricity.

The new machine was designed and is being built by the General Electric Co. at its Schenectady Plant. It will be installed and put in operation in 1930. Its complete technical rating is 110,000 kw., 90 per cent power factor, 13,800 v., 1800 r.p.m., 3 phase, 60 cycles, with steam conditions of 1200 lb. gage pressure; 725 deg. F. total temperature; reheat to 550 deg. F., and one inch vacuum.

Steam will enter the upper high-pressure turbine unit at 1200 lb. pressure and, after producing 55,000 kw., will flow into reheaters. In these reheaters, steam at 1200 lb. pressure direct from the boilers will reheat the steam exhausted from the high-pressure unit where it will produce another 55,000 kw.

Air coolers will be built integral with the generators and will be connected so that the heat losses in the generators will be recovered and returned in the feed-water.

To supply cooling water for the new unit a tunnel will be constructed connecting the River Rouge with the Detroit River. This tunnel will be 3½ mi. long, 15 ft. in diameter and will deliver 600,000,000 gal. of water every 24 hr.

Steam for this new turbine unit is to be made by two of the largest steam generating units ever built for such a high pressure. They are to be furnished by Combustion Engineering Corp. These units are designed for 1350 lb. steam pressure and total steam temperature of 750 deg. F. Each unit will have a maximum capacity of 700,000 lb. of steam per hour.

These boiler units will be fired by pulverized coal, the fuel entering the furnaces tangentially at the corners to give a turbulent mixing action of fuel and air for combustion. Furnaces will be of the all-metal, water-cooled type and air preheaters will be installed to use the heat of the exit gases for preheating the combustion air.

FOR GENERAL power plant service, centrifugal and direct-acting steam pumps are the most widely used, although rotary and power pumps find considerable application for oil handling. Formerly, when steam-driven auxiliaries were widely used, the direct-acting pump was most popular. Such pumps have the steam and water pistons on the same rod, have a small number of working parts and are reliable.

When built with one steam cylinder and one water cylinder, they are known as simplex and if built with two steam and two water cylinders, they are known as duplex. In the duplex pumps, which are really two simplex pumps built side by side, one side operates the valve mechanism of the other side. In simplex pumps, reversal of the stroke is accomplished by mechanical means either by levers or tappets operating a steam thrown auxiliary valve. The sizes of these pumps are stated by giving, first, the diameter of the steam cylinder, then the diameter of the water cylinder and then the stroke, all measured in inches, such as, 6 by 4 by 6.

With the advent of the extraction cycle and motor driven auxiliaries, and the improvement of small steam turbines, centrifugals came into wide use, particularly for boiler feed, circulating water, condensate and general service. Centrifugal pumps require a minimum space, require little attention, have few parts, can be operated at high speeds and are readily adapted to automatic operation.

SEPTEMBER SALES OF MECHANICAL STOKERS, as reported to the Department of Commerce by the 10 leading manufacturers in the industry, totaled 152 with 44,485 hp., as compared with 199 of 54,929 hp. in August and 161 of 65,060 hp. in September, 1928.

Solving System Problems *by means of the* Power Network Analyzer

Model constructed at the Massachusetts Institute of Technology, is applicable to the solution of operating problems met with in alternating networks of various kinds

By H. L. Hazen and M. F. Gardner
Massachusett Institute of Technology

ENGINEERS and physicists have long appreciated that intricate calculations can be dispensed with if suitable models can be constructed which will serve for experimental solutions of the problem on a reduced scale. It is not surprising, then, that electrical engineers, confronted with the difficulties of making frequent computations for their complicated power system networks, should devote attention to developing convenient electrical reproductions of these systems.

Models which have been developed for power network calculations have, in general, been of two types—direct-current, short-circuit calculating tables and alternating-current miniature power systems.

The direct-current models have been developed to aid in short-circuit analysis. Their use is based on the assumption that the limitation of the short-circuit current is due almost entirely to the reactances of the circuit, and that the effects of resistances and capacitances are negligible. Only the reactances are represented in the model and furthermore they are treated as scalar quantities with no attention to impedance angles. Due to these approximations, the direct-current model can be used only for short-circuit calculations. It is of no value for normal system studies and stability analysis where angles between voltages and the complex magnitudes of impedances must be considered.

The desirability of solving normal operating problems experimentally led to an alternating-current representation in the form of a miniature system. Impedances were represented completely as complex quantities, while generators and large shaft loads were represented by small rotating polyphase machines. Such a model proved much more versatile than the direct-current type but difficulties in the manipulation of more than a few of these small machines, with their bad tendency to hunt out of synchronism, set a limit to the complexity of system which might be studied practically by this means. As a network computing device, it left much to be desired; a more practical model was needed which would be simple and accurate.

Development of the Network Analyzer

A model system of entirely new design has recently been built which makes possible the solution of power network problems of both the routine and research types. It is complete enough for studying either the circuits of a metropolitan district or the transmission system of a superpower system interstate in proportions. In it are embodied much of the simplicity of the direct-current table with the alternating-current feature of the miniature system. It has complete stability, which the latter lacked, due to the use of static models for all synchronous machinery. This alternating-current calculating table, or network analyzer as it is called, has been built in the Electrical Engineering Research Laboratory of the Massachusetts Institute of Technology, with the General Electric Co. and the Institute coöperating closely in its development, design and construction. The experience of O. R. Schurig of that company with the miniature alternating-current system referred to above was particularly valuable in the development of this new model.

Analyzer Based on One Line Diagram of System

On the network analyzer, the power system is represented by a single-phase circuit based on the one-line diagram of its network. Power lines are represented as complex impedances, using for this adjustable lumped resistances and reactances. In cases of long lines or cables, capacitance is represented as well, using adjustable capacitors. Transformers are replaced by their equivalent circuits and represented by impedances. Nonsynchronous loads are represented as complex admittances, using here also adjustable resistors, reactors and capacitors. The distinctive feature, however, is the way in which the generators and large synchronous loads are represented.

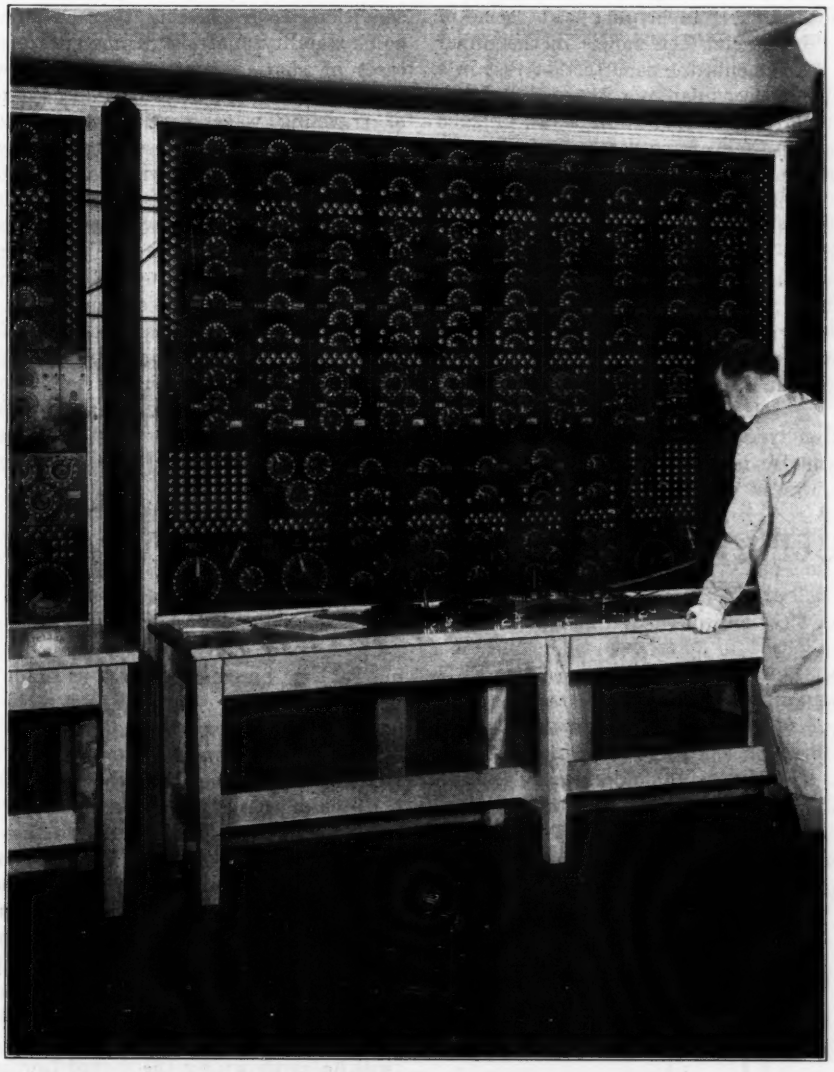
From the standpoint of the external network, a generator may be considered simply a device capable of supplying a voltage of adjustable magnitude and phase angle. This is fortunate. Its representation in miniature does not need to be a rotating machine. It can be duplicated adequately by a phase-shifting transformer having a single-phase secondary winding that can be manually adjusted in space position with respect to its polyphase primary winding. By means of taps on this secondary, and a hand crank to set its phase, the voltage and power which it supplies to the network

can be readily established. Interpreting these in terms of the life-size turbo-alternator, a change of the tap switch is approximately equivalent to adjustment of field excitation; a change of the phase-angle is equivalent to adjustment of governor setting. The voltage which the phase shifter supplies can be considered either the terminal voltage or the excitation voltage of the generator represented. In the latter case, the generator synchronous impedance is represented separately by an adjustable reactor connected in series at the phase-shifter terminals.

While the foregoing has been descriptive of the phase shifter considered as a generator, it can be used equally well as a large synchronous motor or condenser. In either case, furthermore, it can represent a combination of generators such as in a power house, or a combination of large synchronous motors considered as concentrated at a load point.

Conversion from actual system to analyzer quantities, and vice versa, is done on a percentage basis; there is a kv-a. on the actual system to which all its values are referred. On the analyzer, the base quantities are conveniently taken as 200, 0.5 amp., and 0.1 kv-a. at 60 cycles per sec.

There is a close interdependence between the choice of metering schemes to be employed on a model and the selection of its base current and voltage. This model has been designed for use with thermocouple ammeters and voltmeters, and suspended-armature wattmeters,—except at each phase shifter where a set of standard instruments is connected permanently. The use of thermocouple and suspended-armature type instruments does not introduce complications as these types are now nearly as well standardized as instruments of the more conventional form. The calibration and constants of these meters are such that readings of current, voltage and power can be made directly without the necessity of consulting calibration charts or correcting readings to compensate for instrument losses or impedance drops. This is true in all cases except where accuracies better than the normal one per cent uncertainty of the table is desired.



ONE OF THE FOUR SECTIONS IN THE NETWORK ANALYZER DESIGNED FOR EXPERIMENTAL SOLUTION OF POWER TRANSMISSION AND DISTRIBUTION PROBLEMS

The present development of the network analyzer consists of four main sections, all similar to the one shown in Fig. 1. Each of these includes a steel cellular framework and its accompanying instrument table. The framework of each of the four sections contains 25 resistors, 25 reactors, 8 capacitors, 2 artificial generators, 2 synchronous impedances, and a system of 37 buses with outlets distributed liberally over the face of the section. Each of the units is mounted integral with its own control panel. Connections between units and buses are made by short taper-plug leads, some of which can be seen interlacing the panels in the upper left corner. The instruments for each section rest in a recess in the top of its accompanying instrument table. Connections to these are made by flexible leads, plugged into jacks mounted on each of the reactor panels. On two of the sections there are two auto-transformers with a range of taps. These can be used to represent ratio-changing transformers in the miniature circuits.

This new form of model has been developed to be of service in the solution of the three common types of network problems which experience has shown designing and operating engineers must frequently solve. They are the problems associated with normal load studies, short circuit investigations, and stability analysis.

Those of the first type are probably the most numerous, arising continually in the course of normal operation of a system and in its extension and readjustment with growth. The second type represents those which have been studied previously on direct current calculating tables with much approximation. Those of the third type are becoming more frequent as systems increase in size and knowledge of steady-state load limits and of transient stability assume increasing importance.

The analyzer is limited to the representation of a steady state or a succession of steady states and as such is admirably suited to determine the steady-state conditions corresponding to each step in a point-by-point stability analysis. Unbalance and unsymmetrical cases of short circuit readily come within its scope. On the other hand, it cannot be used for investigations of traveling waves, arcing grounds or corona, since each setting must represent the steady state of a network of fixed elements with definite terminal conditions at generators and loads. It is a model of great flexibility, suitable for duplicating practical operating conditions of extensive networks, its limits being set only by the number of units available and the extent to which the connection diagram of the real system can be simplified by preliminary combinations or omissions. Although developed primarily for student instruction and research, its size, arrangement and metering equipment have been so designed as to make it suitable for the solution of the network problems of commercial engineering practice and it is available for such use.

Electricity---What It Is and How It Acts*

PART XXXII. THEORY OF THE OPEN OSCILLATOR. DIFFERENCE BETWEEN CLOSED AND OPEN CIRCUITS. HERTZ'S EXPERIMENTS. BY A. W. KRAMER.

WE HAVE SEEN that if an oscillator is to be an effective radiator of electromagnetic energy, it must be of the open-circuit type since in a closed circuit the current in one side of the circuit tends to neutralize the effect of the current in the opposite side. But, how can an oscillatory current be made to flow in an open circuit? All circuits that we have thus far considered have been of the closed type.

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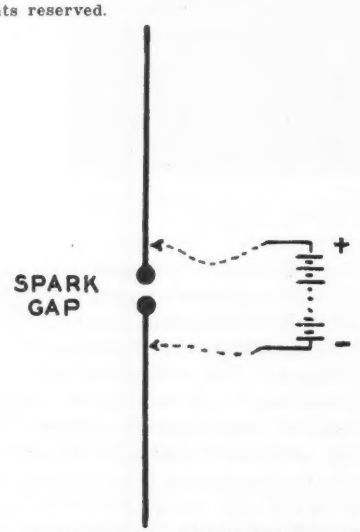


FIG. 1. TWO METAL RODS ARRANGED SO AS TO FORM AN ELECTRIC OSCILLATOR

In Fig. 1 are shown two wires or rods, placed end to end, and separated from each other by a small spark gap. While it may not be apparent at once, a system of two rods arranged in this manner, constitutes a condenser and as such may be made to store a certain amount of energy. Suppose, a battery or other source of high potential is arranged so that the positive and negative terminals can be connected to the upper and lower rods respectively as shown in Fig. 1. Due to the electromotive force of the battery, a number of free electrons will be removed from the upper rod and a like amount deposited on the lower rod. Thus, there will be established between the rods, a potential difference, which tends to restore the system to a condition of equilibrium. The potential gradient along this system will be as shown by the dotted line in Fig. 2. At the extreme ends of the rods, it will be noted, the potential gradient is low but as the spark gap is approached it becomes steeper, reaching its maximum at the gap. The air, or other dielectric between the terminals of the gap, therefore, will be subjected to a dielectric strain.

If this charging process is continued and if the potential of the battery is sufficiently high, the potential stress between the terminals will become so great that the dielectric strength of the air will be overcome and a disruptive discharge will occur, converting the gap from an almost perfect insulator to a comparatively good conductor.[1]

[1]See Electricity—What It Is and How It Acts, Vol. I, p. 96.

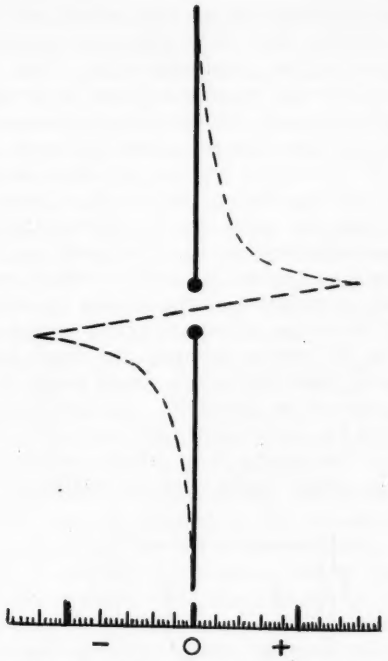


FIG. 2. POTENTIAL GRADIENT ALONG AN OPEN OSCILLATOR PREVIOUS TO BEING DISCHARGED

The upper rod it will be noted is charged positively—the lower one negatively. The reversal of polarity occurs in the spark gap.

Production of Oscillations

Since the tendency of the electrostatic field is to reëstablish a condition of equilibrium, the electrons on the lower rod will start to move upward across the gap into the upper rod, thus creating a current. This current, naturally will produce a magnetic field around the conductor as already described. As the current increases, the store of electrostatic energy decreases.

When half of the excess electrons which were stored on the lower rod have been transferred to the upper rod, the potential difference between the rods will have reached zero, and the electrostatic field will have disappeared. Up to this moment, however, the current has been increasing and at the moment of zero potential, it reaches its greatest value. At this moment, also, all of the energy (minus a certain amount, lost as heat) previously stored in the electrostatic field is now stored in the magnetic field. This energy is now returned to the circuit and manifests itself in continuing the flow of electrons until it (the magnetic field) has disappeared entirely. This results in an accumulation of electrons on the upper rod with a corresponding deficiency on the lower rod, thus charging the system with a polarity just opposite to the original one, that is the upper rod will now be charged negatively and the lower one positively.

Since, at the moment the electrostatic field is fully reëstablished, the current in the system is zero, and no current passes across the spark gap, it might be assumed that the gap would recover its insulating qualities, and since the potential difference between the two rods is now slightly less than it was originally due to the heat loss, it might be thought that further action would cease. This, however, is not true, due to the heat produced in the gap. The current passing across the gap heats the air in the immediate vicinity and also, no doubt, vaporizes some of the material of which the spark gap terminals are made. These hot gases and vapors are not dispersed immediately and persist for a short time after the current itself has decreased to zero, and the gap thus retains its conducting properties for an appreciable time. Hence, the electrons in the upper rod will, under the action of the reversed electrostatic field, now pass downward into the lower rod. In this way, the process repeats itself until the potential is no longer able to maintain a current across the gap. At this instant, the gap recovers its insulating properties and the action ceases.

It must be obvious that the potential distribution along a system of this kind varies during the cycle. The potential distribution indicated in Fig. 2 holds only for the condition in which the system is fully charged and no current is flowing. During the latter part of the discharge, the greatest accumulation and deficiency of electrons is at the ends of the rods. The distribution of current, however, is such at this moment, that the maximum is at the center of the system, that is at the spark gap. The values of current and potential are indicated diagrammatically in Fig. 3.

Open and Closed Circuits

From the foregoing, it is obvious that an open circuit such as described functions exactly as does a closed circuit containing a condenser and an inductance. This should not be surprising for if this open circuit is analyzed, it will be found that the open circuit is not fundamentally different from the closed circuit, or perhaps we should say, the closed circuit is not fundamentally different from the open circuit. Consider the closed circuit shown at A in Fig. 4, consisting merely of a condenser in series with a spark gap. This circuit also has inductance in the conductors serving to connect the condenser with the spark gap. Having both inductance and capacity, it is an oscillatory circuit.

Suppose now that the conductors of the circuit are bent so as to separate the condenser plates as indicated

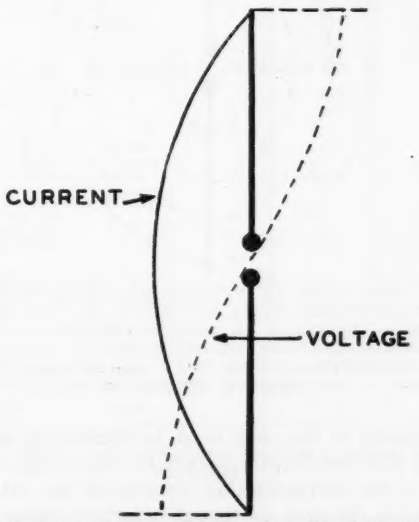


FIG. 3. POTENTIAL AND CURRENT DISTRIBUTION, DURING DISCHARGE

The current is greatest at the center of the system while it is zero at the ends. The potential is zero at the center but is at maximum at the ends.

at B. While the form is changed, it is quite apparent that fundamentally the circuit is still the same. The capacity of the condenser is less, of course, but the circuit still contains both essentials (inductance and capacity) for an oscillatory circuit. Now picture this bending procedure to be carried still further as indicated at C. While the capacity is still more reduced, the circuit has lost none of its properties necessary to produce oscillations. Physically, however, the circuit has been altered considerably and resembles an open circuit more than it does the conventional closed circuit. From this point, it is necessary to proceed only a step

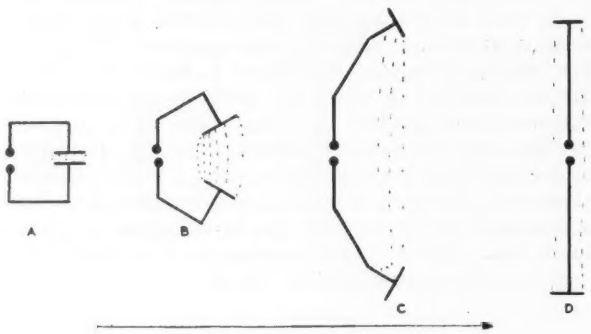


FIG. 4. EVOLUTION OF THE OPEN CIRCUIT FROM THE CLOSED CIRCUIT

farther to produce the typical open circuit shown at D.

It may be insisted upon, however, that the circuit shown at D is different from the circuit shown in Fig. 1 due to the presence of the condenser plates. The presence of these plates, however, does not alter the circuit fundamentally, for the capacity of the system must not be thought of as existing only in the plates.

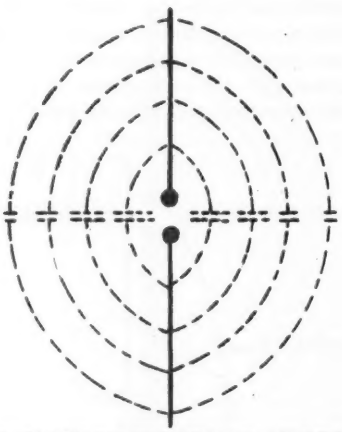


FIG. 5. THE CAPACITY EFFECT OF AN OPEN CIRCUIT OSCILLATOR IS THE SAME AS WOULD BE OBTAINED BY CONNECTING VARIOUS SIZE CONDENSERS AS SHOWN, USING LARGE CONDENSERS TO CONNECT CLOSELY ADJACENT ELEMENTS OF THE RODS AND SMALL ONES FOR REMOTE ELEMENTS

Each element of the rods must be considered as being one side of a condenser surface of which the opposite surface is the corresponding element in the other rod. The effect is the same as though a large number of condensers were connected across the upper and lower rods in the manner shown in Fig. 5. As shown on this diagram, it will be noted, the condensers connected across those elements of the rods which are close together are larger than those connected between those elements more remote from each other. This is shown thus to simulate the actual conditions in the open circuit, for it is apparent that the capacity between remote elements is less than between closely adjacent elements.

While in each of the types of oscillators described, a spark gap was included in the circuit, it must not be construed that the spark gap is an essential requirement of an oscillatory circuit. The spark gap is introduced merely as a means whereby a certain amount of energy can be supplied to the system in small increments. If the entire initial amount of energy could be supplied to the system instantly the spark gap could be eliminated, and oscillations would occur in exactly the same manner as described. As a matter of fact, once the gap has broken down and the initial discharge takes place, the system is in effect a continuous conductor. In actual radio circuits oscillatory circuits

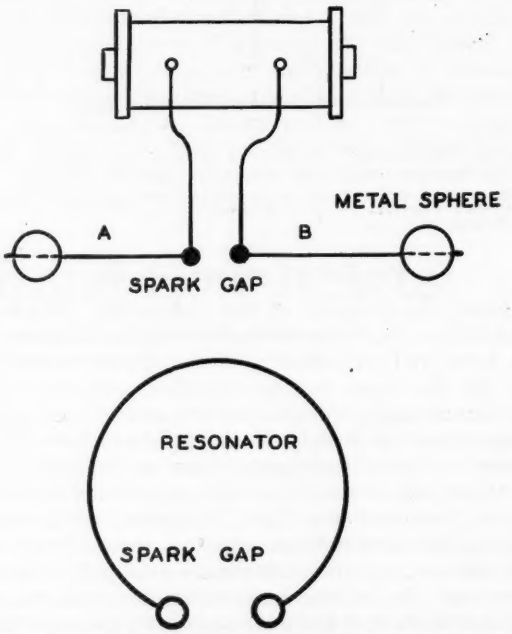


FIG. 6. THE HERTZ OSCILLATOR AND RESONATOR

without spark gaps are used, the current being induced in these circuits by electromagnetic or electrostatic induction.

Hertz's Experiments

It was by means of a circuit such as is shown in Fig. 1 or Fig. 4D that Hertz first proved the existence of electric waves. Maxwell, it must be understood, predicted the existence of these waves mathematically before they were discovered. Hertz used an arrangement similar to that shown in Fig. 6. It consisted of two discharge rods A and B on which were mounted two metal spheres as shown. At the center, the adjacent ends of the rods formed a spark gap and at this point, also, the rods were connected to the terminals of a high voltage induction coil. The high potential produced between the terminals of this coil served to charge the system and where the critical voltage of the gap was reached a discharge occurred across the gap and oscillations resulted.

These oscillations were of extremely high frequency, probably in the neighborhood of 200,000,000 per sec. Naturally, no known equipment available at that time[2] was capable of detecting electrical oscillations of such high frequency but Hertz devised a means which was at once so simple and so obvious that their existence was established beyond question of a doubt.

Hertz was a pupil of Helmholtz and was therefore familiar with the laws of resonance in acoustics. He therefore devised a resonator which would respond to electric waves of the frequency to which it was tuned in the same way that one tuning fork will respond to another vibrating at the same frequency.

This resonator consisted merely of a single loop of wire containing a small spark gap. When this loop of wire was placed a short distance from the oscillator when the latter was in operation, a small spark would appear between the gap in the resonator.

The appearance of the spark was, of course, due to an oscillatory current induced in the resonator circuit by electric waves sent out from the oscillator. It was found that by varying the distance between the metal balls along the oscillator rods, the intensity of the spark in the resonator gap could be increased or diminished or it will cease entirely. This indicated plainly that the resonator would respond only to waves, or electric oscillations of a certain frequency or wave length, that is, the frequency to which the resonator itself was tuned.

The same fundamental principles embodied in Hertz's simple equipment are in use in the modern radio stations of today. Although very much more complex, the modern radio transmitter is simply a tuned oscillator and the receiving set is a tuned resonator.

[2] 1887.

Official Tests of Busch-Sulzer Diesels for Shipping Board

OFFICIAL TESTS made, under the supervision of representatives of the United States Shipping Board, on two 4000-hp. Diesel oil engines recently furnished by Busch-Sulzer Bros. Diesel Engine Co., showed high efficiency of operation, as will be seen by examination of the accompanying tabulated data, which represents a brief summary of data obtained during two tests made on the engines.

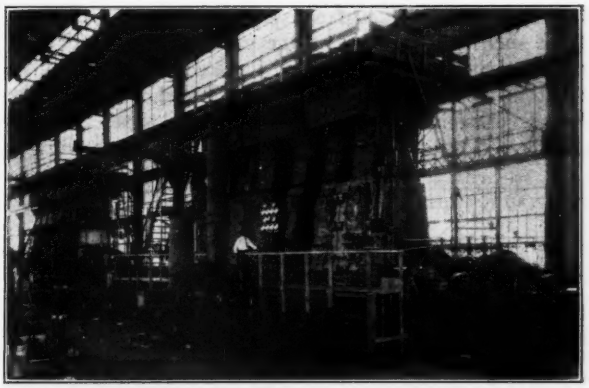
It is interesting to note, since the same manufacturer builds both types, that the two-cycle type was again selected by the Board and that high piston speed for large engines of this type, approximately 900 ft. per min., characterizes these engines.

These engines are of the standard two-cycle, crosshead, air injection type similar to the first units furnished to the United States Shipping Board by the Busch-Sulzer Co. except that a motor driven turboblower is used to furnish scavenging air instead of an integral tandem double-acting pump which was used in the former set. The engines have six working cylinders, 30-in. bore by 52-in. stroke and are rated at 3950 br.hp. at 104 r.p.m., which is a lower speed and more conservative rating than would be given to engines of this type when used for stationary service.

Fuel consumption is seen to be low, being approximately 0.38 lb. per br. hp-hr. for the engine alone. Allowing for the fuel necessary to drive the scavenging blower, the gross fuel consumption is approximately 0.41 lb. per br. hp-hr.

Centralization of control, as seen in the illustration which shows the two engines set up for shop tests, also characterized these engines. All control apparatus and all gages are so grouped that the operator need not change his position in operating the engine.

Previous to the official tests, a seven day non-stop



TWO 4000-HP. BUSCH-SULZER DIESEL ENGINES RECENTLY BUILT FOR THE UNITED STATES SHIPPING BOARD AS ARRANGED FOR SHOP TESTS

unofficial shop test was run during which the average br.hp. was 3960.43, the average mean indicated pressure, 83.4 lb. per sq. in. and the average mechanical efficiency

Shop Test Engine No.	835	836
Date of Test finished	10-8-28	11-2-28
Duration of Test - hours	168	24
Revolutions per minute	104.23	104.28
B.H.P.	3960.5	3961.
I.H.P.	4854.8	4730.
M.I.P.	83.4	81.46
M.E.P.	68.23	68.20
Mech.Eff. - per cent	81.5	82.80 *
Scavenging Blower Motor Input	186.4	204.5
Fuel Oil Consumption		
Pounds per B.H.P. Hour	0.384	0.384
" " I.H.P. Hour	0.321	0.327
" " B.H.P. incl.blower	0.415	0.411 **
Lubricating oil - gals. per 24 hrs.		
Power cylinders	17.9	18.5
Air Compressor	.23	.563
Temperatures - Deg.F.		
Cooling Water to Engine	67.0	60.5
Cooling Water from Engine	104.	102.0
Exhaust in Tee - Deg.F	484.3	567.2
Pressures - lbs. p. sq. in.		
Injection air	825	875
Scavenge air	1.5	1.5
Cooling Water	9.4	5.9
Fuel Characteristics		
Gravity Baume at 60° F.	23.9	25.9
Viscosity (Saybolt Furol at 77°F.) - Sec.	129	45
Sulphur - per cent	.55	
Heat Value(high) - B.T.U. p. lb.	19290	19170

* 79.6% blower included
** Blower included and corrected to heating value of 19000 B.t.u. per lb.

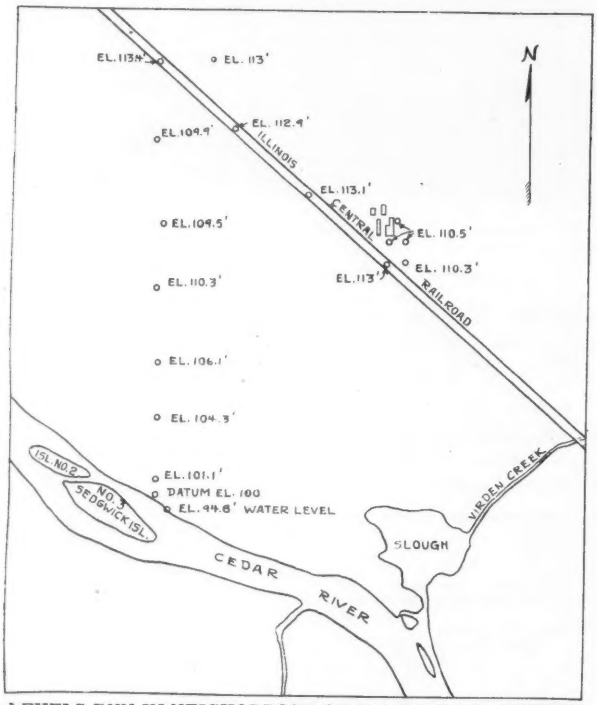
OFFICIAL SHOP TEST DATA OF BUSCH-SULZER DIESEL ENGINES

82.05 per cent. During this test the average fuel consumption per net br.hp-hr. for fuel having a heat value of 19,140 B.t.u. per lb. was 0.4059 lb. This gave a thermal efficiency on the brake of 34 per cent.

Investigating Cause of Water Seepage

Overcoming Trouble Due to Unanchored Oil Tanks Rising Because of Ground Water. By C. C. Hermann

NO DOUBT many manufacturing plants have experienced at some time or other a sudden rise in the hydrostatic level of the soil moisture about the plant. Occasionally we hear of considerable damage resulting from such sudden rises of the ground water. This is particularly true about plants where considerable equipment is installed below grade, in basements and pits. I had occasion, at one time, to investigate a case consisting of a sudden rise of water in an oil tank storage



LEVELS RUN IN NEIGHORBOOD OF FLOODED OIL CISTERN

room below grade which caused considerable trouble and damage.

Dimensions of the storage room were: length, 40 ft.; width, 18 ft., and depth, 11 ft. below grade. Two 12,000-gal. tanks having dimensions, length 32 ft. ¾ in. and diameter of 96 in. were installed within the room. The projected area of the tanks was 256 sq. ft. and the volume of the room per inch of depth was 60 cu. ft. The front ends of the tanks had the usual pipe connections for the distribution piping, steam coils and unloading connections. Neither tank was anchored down. The reason given for this was that no water had ever before entered the cellar. The pipe connections formed a slight anchorage against the rise of the tanks in case water should rise in the surrounding soil.

One morning, they found one of the tanks broken away from all pipe connections and floating around in 4 ft. of water. The water had begun to rise several days before but nobody thought it would rise to a point where the iron tanks would float. As long as the tanks contained oil in sufficient quantity, such danger did not exist; it seems, however, that at just this time the average oil consumption was far below normal and purchases were withheld. As a consequence, the tanks contained little oil; in fact, one tank was empty except for a small amount of sludge in the bottom while the second tank contained about 5000 gal. of oil. The empty tank had broken all connections while the other had raised at the rear end, the front end being held down by the pipe connections and the weight of oil shifted forward.

Officials had installed a 50-gal. per min. rotary pump in the pit and were pumping the water into a storm drain. The water level was watched for several days and depth readings taken. The pump was operated continuously. The data thus collected was as follows:

Date	Time	Depth in.	Water removed	Run-in per min. average
10/6	7 a. m.	48		
	5 p. m.	18	4010 cu. ft.	5.7 cu. ft.
7	7 a. m.	14	5615 cu. ft.	6.5 cu. ft.
	5 p. m.	15	4010 cu. ft.	6.7 cu. ft.
8	7 a. m.	15	5615 cu. ft.	6.7 cu. ft.

Up to this time, the pump had been running at a speed of 300 r.p.m. The leakage into the cistern was, at this level, equal to the capacity of the pump at this speed. It was decided to increase the pump speed to 400 r.p.m. in an effort to reduce the level sufficiently to make repairs on the tank and anchor them. Accordingly the change was made, closing the pump down at 7 a. m. on the morning of the eighth and completed by 11 o'clock the same morning. The pump was placed in operation at its increased speed at 11 a. m.

Date	Time	Depth in.	Water removed	Run-in per min. average
10/8	7 a. m.	15		
	11 a. m.	Total run in approximately 1600 cu. ft.		
	5 p. m.	9	2900 cu. ft.	7.5 cu. ft.
10/9	7 a. m.	9	6738 cu. ft.	8 cu. ft.

Leakage into the cistern was at this time equal to the pump capacity, making it impossible to lower the water level further with the same pump. The depth, however, was reduced to a point where the necessary repairs could be made so the pump was kept operating continuously while the repairs were made.

Regarding the wall of the cistern, a 6-in. concrete wall had been put in at the time the cistern was installed and later a 4-in. wall was poured over this using 1 to 2 mixture. The floor and wall were cast solid and the joint around the tanks was well calked with okum. The rear portion of the cistern was not floored, explaining why the water flowed into the space so freely. The floor area was 720 sq. ft. and assuming that all the

water came through the floor and taking an average figure of 8 cu. ft. per min. for the in-flow with a 9-in. depth of water in the cistern the leakage per square foot of floor area was 0.0111 cu. ft. of water per square foot of floor area.

At a distance of approximately a mile from the plant, the Cedar River, the nearest stream of any size, flowed southeasterly. It was thought that the height of the river was such as would cause water to back up in the soil. This contention was strengthened by the fact that 4 to 6 ft. of water stood in a stone quarry pit approximately one mile north and west of the plant. Levels were run from the water level in the Cedar River near Sedgwick Island No. 3 to the stone quarry directly north and thence down the Illinois Central Railway to the plant. The accompanying blueprint shows the levels along this route and the relative locations of the various points. The results of this level were as follows: Water level in stone quarry 9 ft. 4 in. above water level in river. Water level in oil cistern 8 ft. 9 in. above water level in river. There was little if any difference between the elevation of the water surface at the point in Cedar River where the level was taken and the crest of the dam shown farther down the river near Fourth Street bridge.

Off to the east of the plant is Virden creek flowing into a slough directly south of the plant. No level was run to Virden creek; however, the back water from the river extended but a little way beyond the confines of the slough.

The difference in the water level between the stone quarry pit and the oil cistern is noticed as 7 in. This does not represent the soil friction between the two points or their relative distance from the river, since the land around the stone quarry is quite hilly and contains numerous springs. The water supply at this point would naturally be greater than nearer the plant.

Difference in the water level at the stone quarry, oil cistern and river does, however, represent the soil friction or capillarity between these points. It is apparent from the levels run that the topography of the district is comparatively flat and that where the basements, cisterns and pits are exceedingly deep considerable trouble would be experienced from water. In fact, most of the dwellings throughout the district are in danger of basement dampness in wet seasons or in case of extremely heavy rains. Investigation of the sewer near the plant disclosed that the bottom of this sewer was fully 4 ft. above the bottom of the oil cistern, making it impossible to drain the cistern to the sewer.

It was apparent from the data collected that the only recourse was to waterproof the cistern and anchor the oil tanks down securely against the water pressure. The weight of the tank is 15,802 lb. With 48 in. of water in the cistern, the weight of water displaced would be 49,862 lb. Deducting from this the weight of the empty tank, we have 34,000 lb. representing the anchorage that must be provided. This is assuming that the water level would not rise above the 48-in. mark. In other words, assuming the tanks to be empty they would float with 20 in. of water in the cistern.

The tanks were anchored down by making use of a concrete floor above the tanks. Six-inch I beams were placed under the floor in order to distribute the pressure uniformly and tie rods were placed between the beams and a 6-in. concrete wall extending around the cistern. The total weight of the concrete floor was approximately 85,000 lb. and the two side walls approximately 100,000 lb. The floor was reinforced concrete so that by the use of the beams the greater weight of this concrete could be utilized.

Charts for Determination of Combustion Losses

GRAPHICAL METHOD OF DETERMINING COMBUSTION LOSSES. BY C. A. BUTLER, JR.*

AMONG OTHER CHARTS included in Jay G. Huntoon's article on "Study Your Boiler Losses for Better Efficiency," published on page 562 of the May 15 issue, was a chart for calculating the loss from unburned combustible in refuse, the known quantities

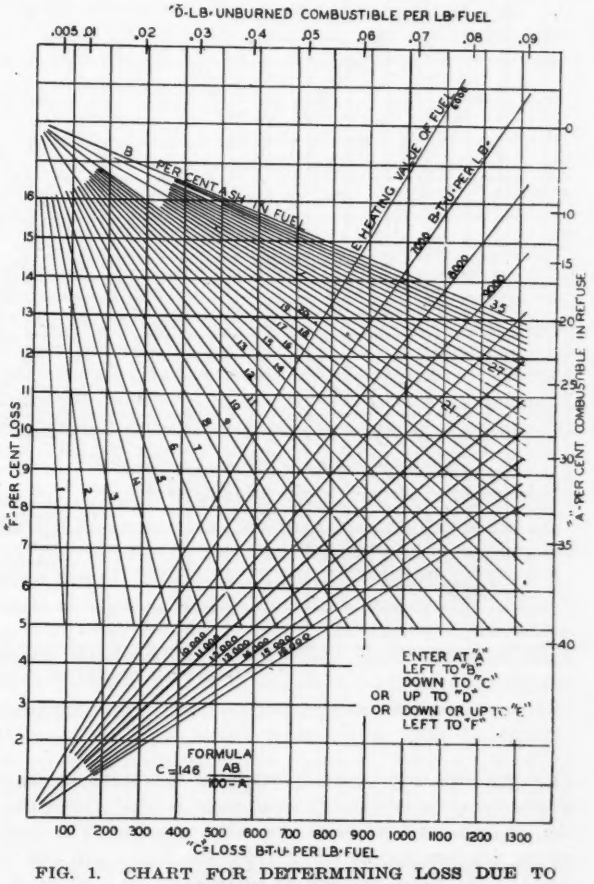

"D"-LB. UNBURNED COMBUSTIBLE PER LB. FUEL
.005 .01 .02 .03 .04 .05 .06 .07 .08 .09
PER CENT ASH IN FUEL
HEATING VALUE OF FUEL
B.T.U. PER LB.
"F"-PER CENT LOSS
"A"-PER CENT COMBUSTIBLE IN REFUSE
ENTER AT "A"
LEFT TO "B"
DOWN TO "C"
OR UP TO "D"
OR DOWN OR UP TO "E"
LEFT TO "F"
FORMULA
C = 146 AB / 100 - A
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300
"C"-LOSS B.T.U. PER LB. FUEL

FIG. 1. CHART FOR DETERMINING LOSS DUE TO COMBUSTIBLE IN ASH

necessary to obtain this loss being the per cent ash in the coal and per cent of total refuse.

Many plants are not so fortunate as Mr. Huntoon's, in being equipped with ash disposal systems which will allow the determination of the exact weight of the refuse from any one boiler without interfering seriously with ordinary plant operation.

At that plant, with which the writer is familiar, the stokers are equipped with ash hoppers which dis-

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charge individually into standard railroad cars. Thus the ash collecting in the hopper of any particular boiler during any desired length of time may be emptied into a car and weighed on track scales in the the yard. This weight divided by the weight of coal fired during the same period multiplied by 100 is the per cent of total refuse.

In many plants, samples of the ash coming from the boilers are taken in the same manner as samples of coal are obtained. These are analyzed in the laboratory to determine the per cent combustible in the refuse

Calculation of the loss due to the unburned combustible in the ash from the known quantities, per cent combustible in refuse, and per cent ash in the coal may be made by the accompanying chart, Fig. 1, on which the formula used and the manner of using the chart are shown. If the per cent ash in coal as fired is used, the result will be given as loss in B.t.u. per pound of coal as fired and the heat value of the coal per pound as fired must be used to obtain the per cent heat loss.

Since the unburned combustible is almost entirely pure carbon, this chart may also be used to obtain the

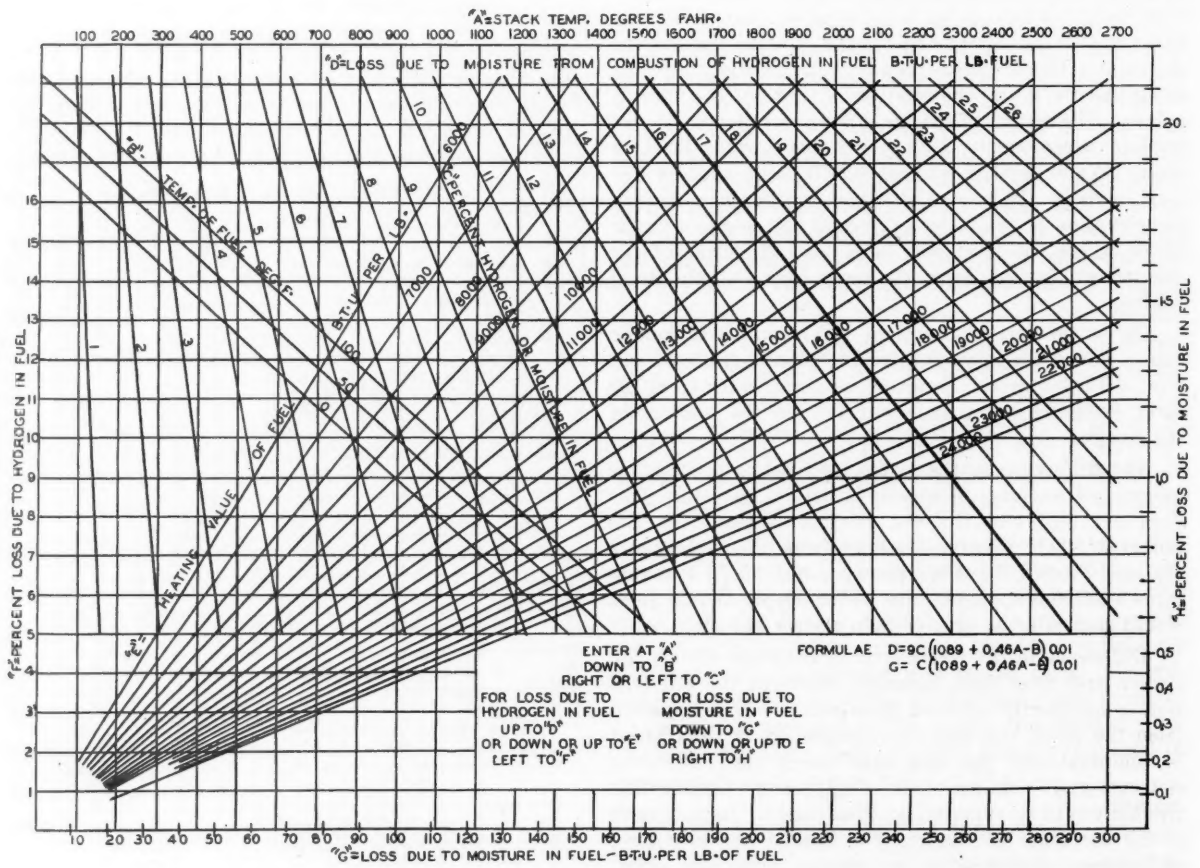

"A"=STACK TEMP. DEGREES FAHR.
"D"=LOSS DUE TO MOISTURE FROM COMBUSTION OF HYDROGEN IN FUEL B.T.U. PER LB. FUEL
"B"=TEMP. OF FUEL DEG. F.
"C"=B.T.U. PER LB. OF FUEL
PERCENT HYDROGEN OR MOISTURE IN FUEL
HEATING VALUE OF FUEL
"F"=PERCENT LOSS DUE TO HYDROGEN IN FUEL
"H"=PERCENT LOSS DUE TO MOISTURE IN FUEL
"G"=LOSS DUE TO MOISTURE IN FUEL-B.T.U. PER LB. OF FUEL
ENTER AT "A"
DOWN TO "B"
RIGHT OR LEFT TO "C"
FOR LOSS DUE TO HYDROGEN IN FUEL UP TO "D" OR DOWN OR UP TO "E" LEFT TO "F"
FOR LOSS DUE TO MOISTURE IN FUEL DOWN TO "G" OR DOWN OR UP TO E RIGHT TO "H"
FORMULAE D=9C(1089+0.46A-B)0.01
G=C(1089+0.46A-B)0.01

FIG. 2. CHART FOR DETERMINING LOSS DUE TO MOISTURE IN FLUE GAS

This analysis may be easily made in the plant in cases where complete laboratory equipment is unavailable and the coal analysis made at the mine is used. The composite ash sample, as taken from the boiler ash pit, is crushed and then reduced by quartering, in exactly the manner used in reducing a coal sample to laboratory size. The amount then taken is that which would be required to fill a pint jar. This is pulverized and further reduced by quartering until a sample weighing about 10 grams is obtained. This is accurately weighed and then heated to incandescence in a small crucible over a gas flame or in an electric oven, until repeated weighings of the crucible and its contents show no further loss in weight. The per cent combustible in the refuse is equal to the loss in weight divided by the original weight of the sample multiplied by 100.

pounds of unburned carbon per pound of fuel. As in the case of the loss due to the unburned combustible, the per cent ash in the coal as fired or dry, when used in applying the chart for any given calculation, will give results in the pounds of unburned carbon per pound of coal as fired or dry, respectively. The total carbon in the coal, as taken from the coal analysis, less the unburned carbon, is the amount of carbon burned per pound of coal. This quantity is used in applying several of the charts included in Mr. Huntoon's article.

Loss due to moisture in flue gas is indicated in Fig. 2. This chart contains a provision for obtaining the losses in per cent as well as in B.t.u. per lb. of fuel and it is extended beyond Mr. Huntoon's charts so that it may be used in connection with oil and gas-fired furnace calculations as well as with coal-fired furnaces.

Code for Piping Ready for Discussion

TENTATIVE A.S.E. CODE FOR PRESSURE PIPING OF POWER SYSTEMS COVERING MATERIAL SPECIFICATION, DIMENSIONS, ETC., ISSUED BY A.S.M.E. COMMITTEE*

DESIGN, manufacture, test and installation of power piping systems in steam generating stations, central heating plants, industrial process work and all distributing systems where the pressure is in excess of 15 lb. is covered by Section II of the Code for Pressure Piping, just issued in tentative form under the Procedure of the American Standards Association by the Sponsor Organization, A.S.M.E.

Tentative specifications for materials used are shown in Table I. The use of materials and construction having properties superior to the minimum requirements given in this table is permissible. In general, cast iron shall not be used for any service in excess of 450 deg. F.; bronze and brass fittings and valves shall not be used for any service in excess of 500 deg. F. while brass and copper pipe shall not be used for any service in excess of 406 deg. F. or 300 lb. pressure, and wrought iron pipe shall not be used for any service in excess of 750 deg. F. or 400 lb. pressure.

TABLE I. SPECIFICATIONS FOR MATERIALS MENTIONED IN THE CODE

	A.S.T.M. Specification
Cast iron	A-126
Cast iron	A- 95
Forged steel	A-105
Bronze and brass (for flanges, valves and fittings)	B- 61?
Malleable iron	A- 47
Bolts—alloy steel	A- 96
Bolts—commercial steel	.....
Bolts—wrought iron	A- 84
Pipe—steel—up to 249 lb. working steam pressure	A-120
Pipe—steel—250 lb. working steam pressure and over	A-106
Pipe—brass	B- 43
Pipe—copper	B- 42
Pipe—wrought iron	A- 72

Piping, fittings and valves pertaining to boilers shall be as prescribed in the latest issue of the A.S.M.E. Boiler Construction Code, while flanges shall be of the dimensions and drilling corresponding to American Standard for respective pressures. Valves shall be plainly marked with the name or identification mark of the manufacturer and the working steam pressure for which they are guaranteed.

SPECIAL SHAPES PROVIDED FOR

Where special fittings are required to overall dimensions differing from the regular shapes specified under the standard, they shall conform to flange dimensions and minimum metal thickness as specified while special fittings such as welded tees and elbows may be used if made in compliance with requirements of later sections of the code.

In general, thermal expansion shall be taken up by pipe bends, offset or changes in direction of the pipe line itself. Expansion joints of either the slip-sleeve or swivel types may be used for the pressure and temperature for which the connecting pipe is suitable, provided, however, (a) the materials, including the packing used in their construction are suitable for the service intended; (b) the design provides proportions for the structural and working parts ample therefor; and (c) for pressures in excess of 15 lb. the design embodies provision against complete disengagement of the working parts while in service.

Unsupported corrugated expansion joints shall not be used for steam pressure exceeding 25 lb. per sq. in. Corrugated expansion joints when reinforced with exterior rings or sleeves may be used for steam pressures not exceeding 125 lb.

The maximum combined fiber stress due to internal pressures, thermal expansion and dead weight between supports shall not be in excess of 15,000 lb. per sq. in. It is recommended that piping shall be cut short about 50 per cent of the amount of thermal expansion and cold sprung during erection. The amount of cold springing, however, shall not be credited as reducing the calculated bending stress due to thermal expansion.

FIREPROOFING MATERIALS SPECIFIED

Piping and equipment shall be supported rigid enough to prevent excessive vibration and anchored sufficiently to prevent undue strains on boilers and equipment served. Hangers, supports and anchors shall be made of non-combustible and durable materials. Wood or wire shall not be used for permanent construction inside a power plant or tunnel. These supports shall be so installed as not to interfere with the free expansion and contraction of the piping between anchors. Hangers for pipes larger than 3½ in. shall be capable of screw adjustment after erection. Straps, pipes or bars of equivalent strength may be used for pipes 3½ in. and smaller. Straps, if used, shall not be less than 3/16 in. thickness.

Hangers and supports, except in the case of springs, shall have a factor of safety of 12 with reference to the ultimate strength of the material. All weight calculations shall be based on piping full of water, with heat insulation included if such is to be used. Suitable springs sway bracing, vibration dampeners and such devices shall be provided where necessary and the use of helical springs in compression is recommended in such elements.

Where sleeves pass through walls or partitions not constructed of non-combustible material, a protecting metal sleeve or thimble shall be provided which gives at least ⅛ in. clearance all around the pipe or pipe and

*Discussions and suggestions will be welcomed by the committee. They should be addressed to C. B. LePage, Asst. Sec., A.S.M.E., 29 W. 39th St., New York, N. Y.

covering. Where steam pipes pass through metal partitions, a clearance of at least ¼ in. shall be left and if the steam temperature exceeds 250 deg. F., the pipe shall be insulated inside the sleeve with covering of at least standard thickness.

In no case shall walls, floors, partitions or beams be cast or solidly built around a pipe. Where it is necessary to bury a pipe in a concrete floor or other building member, it shall be protected for the entire length with a protecting sleeve of steel pipe, wrought iron or tile. The only exception to this is when pipes pass through water-tight partitions.

Drains or drips shall be provided wherever necessary to drain the water of condensation from all sections of the piping and equipment where it may collect or for emptying such lines and equipment when they are out of service. Drip lines shall be properly trapped, with the traps below the level of the drained apparatus and in accessible locations. Drip pumps, drip tanks and open discharge drips, preferably with orifice control, may be used in lieu of traps, provided they are safely installed, protected and operated under constant supervision.

Drip lines from steam headers, mains, separators, or other equipment operating at different pressures, shall not be connected to discharge through the same trap. Where two or more drip lines discharge into the same trap, a check valve and a stop valve shall be placed in each line.

Hydrostatic Tests

Prior to erection, all material shall be subjected to and found to meet the inspection and test requirements mentioned in Table I. The inside of all pipes, valves and fittings shall be smooth, clean and free from blisters, loose mill scale and dirt. All lines shall be blown before placing in service. Piping, valves and fittings shall be designed to withstand a hydrostatic shell test equal to the pressure shown in Table II.

Table II. Hydrostatic Test Pressure to Be Used for Various Working Steam Pressure Pipe Fittings

1350 lb. W. S. P. rating	3000 lb. test
900 lb. W. S. P rating	2000 lb. test
600 lb. W. S. P. rating	1500 lb. test
400 lb. W. S. P. rating	1000 lb. test
250 lb. W. S. P. rating	750 lb. test
150 lb. W. S. P. rating (16 in. and smaller)	450 lb. test
125 lb. W. S. P. rating (18 in. to 32 in.)	250 lb. test
125 lb. W. S. P. rating (36 in. and larger)	250 lb. test
125 lb. W S. P. rating	150 lb. test
25 lb. W. S. P. rating	50 lb. test

Specific mandatory requirements are made for different pressure and temperature ranges. For instance, where the steam pressure is from 250 to 1350 lb. with temperatures from 450 to 750 deg. F., all valves and fittings in nominal sizes under 2 in. may have either screwed or flanged openings. Stem threads on gate and globe valves may be either internal or external with reference to the valve body. Valve bonnets may be attached to the bodies by either screwed or flanged connections. Valve bodies and fittings may be made optionally of forged or cast steel or forged or cast monel metal or equivalent. Valves and fittings shall be of American Standard for respective pressure and of cast or forged steel.

All valves and fittings of 2 in. nominal size and larger shall have openings flanged. Stem threads on gate and globe valves shall be external with reference to the valve body and used in connection with an outside yoke and flanged bonnet. Steam valves 8 in. and larger shall be bypassed with a bypass of at least ¾ in. nominal size. Valves and fittings shall be of cast or forged steel.

For pressures in excess of 400 lb., the pipe shall be seamless open hearth steel, made in accordance with A.S.T.M. Specification A-106. For pressures from 250 to 400 lb., pipe shall be either lap-welded or seamless open hearth steel or wrought iron.

Large Valves Must Be Bypassed

The medium pressure range from 125 to 250 lb. and temperatures not in excess of 450 deg. F. all gate and globe valves 2 in. and larger shall have outside screw and yoke except where clearance limitations require the use of a non-rising stem valve, in which case an indicator shall be provided. Gate and globe valves under 2-in. size may have inside screw. All gate valves 8 in. and over shall be bypassed. Bodies, bonnets, discs and yokes shall be of cast iron or other material allowed under the code.

All fittings shall be of the 250-lb. American Standard, either screwed or flanged, except that the 150-lb. American Standard malleable iron screwed fittings or 150-lb. steel fittings, may be used up to 150-lb. steam pressure. Pipe shall be of steel, wrought iron, copper or brass used under the limitations given earlier.

Boiler Feed and Blowoff Systems

For boiler feed systems and hot-water systems over 250 deg. F., piping and fittings shall be designed in accordance with Table III. No bypasses shall be required for pressures under 600 lb., for pressures in excess of 600 lb. it is recommended that all 8-in. valves and over be equipped with a bypass of at least ¾ in. nominal size. Brass or copper pipe may be used where pressure of 300 lb. gage or temperature of 406 deg. F. is not exceeded.

Blowoff piping systems shall be designed for maximum pressure of boilers connected to them, except that for boiler pressures above 600 lb., 600-lb. material may be used. This applies to entire system from blowoff valves on boilers to blowoff tank or other point where pressure is reduced to approximately atmospheric pressure.

Table III. Boiler Feed Systems Are Designed in Accordance with the Following Values

For Water Pressures of	Use Steam Pressure Specifications of
Below 175 lb.	125 lb.
175 to 325 lb.	250 lb.
325 to 500 lb.	400 lb.
500 to 720 lb.	600 lb.
720 to 1080 lb.	900 lb.
1080 to 1625 lb.	1350 lb.

Service water and vacuum systems of from 50 to 175 lb. shall be designed as for 125 lb. steam pressure. For systems up to 50 lb., the pressure shall be designed as for 25 lb. steam pressure. Bell and spigot joints may be used if in accordance with standards of American Water Works Association. No bypasses shall be required.

Municipal Plants Co-operate on Fuel Tests

FREMONT, NEB. PLANT TESTS COAL FOR ILLINOIS PLANT. BY P. C. TUCKER*

SPRINGFIELD, Illinois, has a municipal power and light plant that has given excellent service since it started the commercial sale of power in 1916. The city already operated its own water plant. Originally, water from wells was pumped directly into the city mains using steam pumps. In 1925, a complete water softening and iron removal purification plant was completed. Steam turbine driven pumps are used to pump the softened water into the mains with a Holly pump kept in reserve.

In 1914, the city installed two small engine driven generators for supplying electricity for street lighting. From this start the lighting department has grown till at present it has five generators installed, with a total capacity of 16,750 kw. The peak load this winter will probably be over 8000 kw. Located so near the mines that coal can be delivered either by railroad or by truck for less than $2.00 per ton into the bunkers, the low price of coal has made it unnecessary to use expensive heat recovery devices in the boiler room. The plant contains five 525-hp. cross drum boilers, three are fired by natural draft and two by forced draft chain grate stokers. The boiler room is subject to a sharp evening peak load which has exacted a heavy maintenance on the brick settings and arches especially in the forced draft stokered furnaces. At the same time a slagging has occurred on the lower rows of tubes.

Additional boiler capacity is required. In view of the general trend to increase steam pressure and steam temperatures, it was felt that to install additional equipment for the existing steam condition, 200 lb. pressure and 125 deg. F. superheat, would be a mistake. Turbines and other equipment have been so well standardized at 400 lb. and 250 deg. F. superheat as to cost the same as for the lower pressures while the lessened steam requirements have tended to offset the increased cost of boiler room equipment. Condensing equipment costs less due to the smaller condensers. It was decided to go to the 400 lb. pressure and 250 deg. F. superheat when a proposed 10,000 kw. turbine is installed, but to operate in the meantime at 200 lb. pressure and 125 deg. F. superheat.

High furnace maintenance rendered the use of water cooled walls advisable. It was felt that the use of pulverized coal would involve a greater investment than the low price of the coal would justify. Besides the ash from the stack would be objectionable because of the adjacent waterworks.

Due to the good operating results being obtained by plants using underfeed stokers on Illinois coal, it was decided to take bids on underfeed stokers as well as on chain grate stokers. The underfeed lends itself to a very compact installation having great capacity, and without furnace arches to give trouble.

Sangamon County coal is a low grade of Illinois coal ordinarily considered a chain grate stoker coal. While there are plenty of underfeed stoker fired plants burning Illinois coal, yet there were none, as could be ascertained, that burned this particular grade of coal. This made it extremely desirable to run a test on this particular coal before proceeding.

Willis J. Spaulding, Commissioner of Public Property at Springfield, who has directed the course of the municipal plant since 1909, felt that some other municipal plant equipped with underfeed stokers would be glad to coöperate and this proved to be the case. The city of Fremont, Nebraska, has a municipal plant as well known in Nebraska as the Springfield plant is in Illinois. It is under the direction of a Board of Public Works of which J. Rex Henry is Chairman. Mr. Henry graciously consented to run a two-day test on the Sangamon County coal.

Originally the Fremont plant used chain grate stokers and then later switched to the exclusive use of underfeed stokers, having three boilers so equipped. The latest 600-hp. boiler operates at 300 lb. pressure. It is equipped with economizer and air preheater in series and was described in the February 1, 1929 issue of Power Plant Engineering. It was designed for a maximum capacity of 45,000 lb. but normally produces under 30,000 lb. of steam per hour.

TESTS SHOW ABOUT 85 PER CENT EFFICIENCY

Under these conditions, the brick furnace has required the replacement of but 3000 firebrick in 20 mo. operation. A good portion of these subject to abrasion by the stoker were taken out to make room for carborundum bricks. None of the carborundum bricks have been replaced since their installation a year ago. In the last year, the stoker has burned over 8000 t. of coal with a stoker material maintenance of $0.01 per t.

The Fremont stoker firemen were not used to burning the Sangamon County coal and it was cut into use at midnight without notifying them of the change. Although the regular coal averages 2000 B.t.u. per lb. higher, the burning qualities of the two coals were so nearly alike that the firemen were unaware of the change for quite awhile. No difficulties were experienced.

From evaporation, coal analysis and a study of the known losses, the efficiency was found to be almost 85 per cent.

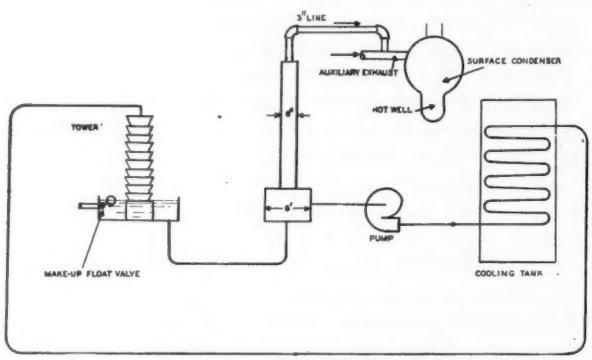
The Springfield operators were delighted with the results of the test and with the cordial reception at the hands of the Fremont officials. The test was conducted by Lon Wright, superintendent of the Fremont plant, and observed by J. W. Curren, superintendent of the Springfield plant. The Burns & McDonnell Engineering Co. are engineers for both plants.

This is the first case of one municipality extending the use of its plant to another for test purposes of which the engineers have heard. It probably will not be the last, since a second plant has since been offered to the engineers for the same purposes.

*With Petroleum Eng., Inc., Tulsa, Okla. Formerly with Burns & McDonnell Eng. Co., Kansas City, Mo.

Long Standpipe Acts Efficiently as Deaerator

SOME TIME AGO, we were troubled with air in the circulating or cooling water used in an experimental process tank. The water was cooled in an atmospheric cooling tower with the makeup controlled by a float



STANDPIPE CONNECTED TO CONDENSER AND PLACED IN WATER LINE REMOVES AIR FROM THE WATER

valve in the reservoir at the base of the tower. The cooling coils were poorly constructed having been built without preliminary design by a pipe fitter and a master mechanic. Bad air pockets, which interfered with the accuracy of the experiments, occurred in the system.

It was impossible to rebuild the tanks at the time so we devised a deaerating apparatus which worked well. The pump, tower and cooling tank are shown in Fig. 1. Apparently the basin at the bottom of the tower was not large enough to allow the entrapped air to escape so, in order to remedy this, we put an old tank, which we had on hand, in the line between the pump and the tower. On the top of this tank, which measured about 6 ft. in diameter, we welded a funnel-shaped piece as shown and welded the top of the funnel to a piece of 6-in. pipe about 35-ft. long, the upper end of which was fitted with a 3-in. line, which was connected to the auxiliary exhaust of the surface condenser.

With the full condenser vacuum of 27 in. the water was obviously drawn up the 6-in. pipe about 30.5 ft. above the cooling tower basin. This condition is the same as that encountered on a barometric condenser, the pump did not have to pump against this vacuum as many seem to think because the "vacuum" is balanced by the column of water which leaves the pressure at the pump suction unchanged.

This improved conditions considerably, although the best results were obtained when the line to the condenser was throttled so that the vacuum carried in the pipe just before the water started to fill the funnel shaped filler piece, was only about 4 in. of mercury. Apparently the better operation was due to the large exposed surface at this point and the fact that the air bubbles traveled such a short distance through the air. Due to the comparatively long time the water took to pass through the tank considerable air was released even under no vacuum.

Brooklyn, N. Y. P. F. ROGERS.

Ice and Debris Removal from Trash Racks

"TROUBLES due to ice have been almost completely solved by the use of electrically heated racks" is a statement found on page 1056 of the Oct. 1 issue. While this statement is doubtless true, I believe the expense of heating trash racks electrically is too great to make the process a commercial success. According to Marks, 1 kw-hr. produces only 3412 B.t.u., therefore the amount of power required to prevent ice from adhering to the racks by heating them electrically would be great and the method does not appear to be feasible, unless considerable surplus power is available.

Some 7 or 8 yr. ago, after concluding that the electrical heating method was too expensive, we tried steam heating with considerable success but at considerable operating cost.

Electrically operated, self cleaning traveling screens appeal to me as the best means for overcoming the ice trouble. Such screens are moderate in cost, low in maintenance, require a minimum amount of attention and are efficient. They take care of ice formation as well as of obstruction by all floating substances such as leaves and small ice chunks. Trouble, which otherwise would occur from the sudden onslaught of young maple leaves, which are sometimes cut off and thrown in a stream by a sharp spring rain, is avoided by the use of such screens.

Some ponds have a certain amount of vegetation at the bottom, which seasonally seems to detach itself or part of itself and float down stream. The traveling screen handles such a situation without difficulty. Be-

fore installing a traveling screen, such great quantities of this vegetation collected on the racks that, at times, the water wheels were nearly shut down.

If a boom, composed of a couple of trees or poles connected butt to butt, is placed across the flume intake ahead of the screen or grating, most of the pulp wood, logs, brush, rubbish and broken ice will be diverted to one side. If water is running over the spillway, a boom of this kind may divert all the debris toward this spillway and it may be passed on through a gate provided for that purpose or the debris may be shunted to either side where it can be readily removed at will or allowed to back up until the floodwater casts it over the spillway. In any case the debris should be removed from the flume intake.

Housatonic, Mass. L. F. HOLMES.

Editor's note: Electrically heated racks for removing ice are used extensively in Scandinavian countries. On page 785, Volume 2 of the Transactions of the First World's Power Conference, Arvid Ruths presents a table, which he compiled, giving data on electrically heated bars as they are installed in Norwegian hydraulic plants. The power consumption there varies from 0.29 to 0.85 kw. per sq. in. of bar surface.

On page 808 of the same volume, A. Frey Samsioe, a Swedish engineer, states that the power consumption for a number of plants examined by him, averages 10 kw. for a screen having an area of 160 sq. ft.

Hot Water Pumping Possible with Right Arrangement

IN ATTEMPTING to increase the temperature in the hot well from 210 to 212 deg., a young engineer found that his feed pump failed to deliver sufficient water to the boilers.

Investigation showed that the feed pump was located slightly above the water level of the hot well and it was impossible to arrange it so that the hot water could flow to the pump. As it was, the water had to be lifted a little more than a foot. Here was where the trouble originated. When the pump drew water from the well, suction was created of a half pound or more per square inch and this caused some of the hot water to flash into steam at less than atmospheric pressure. This steam, filling the pump cylinder, prevented water from entering it and caused the pump simply to churn low-pressure steam instead of raising water and forcing it into the boiler.

It was found necessary, under the conditions, to reduce the hot well temperature to about 196 deg. in order to pump the water properly. This was contrary to the engineer's idea of economy of heat and out at once he set to find a way to put 212-deg. feedwater into the pump. He knew that once in the pump, there would be no trouble forcing the hot water into the boiler.

Among the junk collected about the factory was a small centrifugal pump which, after cleaning and overhauling, was set up in a hole which had been made just outside of the hot well and the water was piped from the hot well through this centrifugal pump to the feed pump. As there was no convenient way to install a regular belt drive, the centrifugal pump was driven by a motor. Water now flowed from the hotwell to the centrifugal pump and, when this pump was in operation, the feed pump handled water at 210 deg. which was as hot as could be secured.

Belt trouble soon developed, however, in the motor drive to the centrifugal pump. When the feed pump was operated at a speed slower than that which gave good results in boosting the water by the centrifugal pump, the latter squeaked, smoked and showed signs of distress. This trouble was cured by cutting the pipe between the two pumps and inserting a 12-ft. standpipe which was open at the top. This standpipe took care of the surplus water delivered by the centrifugal pump but occasionally the standpipe would overflow and drench its surroundings. This was overcome by bolting a couple of elbows to the top of the standpipe and attaching another 12-ft. length of pipe which returned the surplus water to the hotwell.

This arrangement appeared to work well, until suddenly, the feed pump would begin to buck and the centrifugal pump would run as if it were under no load while a full pipe stream of water returned to the hotwell. It was found that water was syphoning over in the standpipe, reducing the hot water pressure in the suction of the feed pump and permitting low-pressure steam to form in the pump as before. A funnel, placed between the second elbow and the return pipe to the hot well prevented further trouble from syphon action and thereafter the installation handled the hot water satisfactorily.

Indianapolis, Ind. JAMES F. HOBART.

Power Research Department Worth While

ALL INDUSTRIAL leaders of today admit that research is producing remarkable results. The United States is forging rapidly ahead largely because of the extensive research departments operated by practically all of our foremost manufacturers. But why confine research solely to large concerns? Officials of the smaller companies seem to believe that research departments are only for the large establishments and that a small organization cannot afford such a department.

No doubt it is true that the small or comparatively small concern cannot afford an extensive research department for doing a great deal of experimenting. But why attempt to begin with a large one? A small one-man research department may be even more efficient than a large one. It all depends upon that one man.

Here is another suggestion: Every industry in the world, regardless of size, must buy as well as sell. Next time you buy, instead of asking for prices and selecting the cheapest, why not pick out the product that looks best and buy it even though it may cost considerably more than the cheapest? The difference in cost between the best and the cheapest may then be charged to "research." Or carry this idea a little farther and buy both, the one that looks best as well as the one that is cheapest. Compare the two, side by side, under identical conditions. Probably you will find that it pays well to invest a little additional money in quality products instead of buying solely on a first cost basis. That is research and it is a kind of worth while research that can be indulged in by any business institution regardless of size.

Newark, N. J. W. F. SCHAPHORST.

Questions and Answers

Comparative Economy of Motive Power Units

How do steam engines, steam turbines and internal combustion engines compare in economy and cost of operation? T. G. S.

A. Economy of operation depends so much on the conditions of operation and costs applying to a specific case vary so much that no flat comparison between steam engines, steam turbines and internal combustion engines would be of any value.

An idea of the comparative performance of these three types of motive power for a 200-kw. plant may be obtained by referring to the accompanying table which was taken from Marks' Mechanical Engineers Handbook.

TABLE SHOWING INVESTMENT AND OPERATING COSTS OF A 200-KW. CENTRAL STATION UNDER DIFFERENT MOTIVE POWER DRIVES

	Non-condensing steam prime-movers, saturated steam				Condensing steam prime-movers, saturated steam				Oil engines	
	Uniflow engines	Counter-flow engines	Turbines	Corliss engine, belted	Uniflow engines	Counter-flow engines	Turbines	Corliss engine, belted	Semi-Diesel	Diesel
Brick building	$ 35,200	$ 35,200	$26,000	$ 43,000	$ 38,000	$ 38,000	$28,800	$ 45,800	$ 26,400	$ 26,400
Generating units del. and erected	31,954	25,504	16,750	23,380	31,954	25,504	19,460	23,380	56,556	85,600
Piping complete	6,500	6,500	6,500	6,500	9,500	9,500	9,500	9,500	2,700	2,700
Condensing equipment	.....	.....	.....	.....	7,000	7,000	7,000	7,000	.....	.....
Foundations exclusive building	4,200	4,200	2,500	4,500	4,700	4,700	2,800	5,000	5,500	4,000
Boilers delivered and bricked in	10,000	13,000	13,000	13,000	10,000	13,000	10,000	13,000	.....	.....
Other costs	21,700*	21,700*	21,700*	21,700*	21,700*	21,700*	21,700*	21,700*	23,100**	23,100**
Total	$109,554	$106,104	$86,450	$112,080	$122,854	$119,404	$99,260	$125,380	$114,256	$141,800
Load factor 25 per cent: Cost of operation, fixed charges 15 per cent	16,433	15,915	12,968	16,812	18,428	17,911	14,889	18,807	17,138	21,270
Load factor 25 per cent: Fuel	9,581	11,956	14,308	13,300	8,939	12,400	9,500	13,850	7,646	5,365
Load factor 25 per cent: Labor and superintendence	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500	4,100	4,100
Load factor 25 per cent: Lubricants	400	400	200	400	400	400	200	400	438	438
Load factor 25 per cent: Miscellaneous supplies	350	350	300	350	350	350	300	350	657	657
Load factor 25 per cent: Repairs	1,738	1,800	937	1,515	2,018	1,880	1,139	1,795	2,262	3,424
Load factor 25 per cent: Cost pumping cooling water	.....	.....	.....	.....	.....	.....	.....	.....	197	197
Load factor 25 per cent: Total	$ 35,002	$ 36,721	$35,213	$ 38,877	$ 36,635	$ 39,441	$32,528	$ 41,702	$ 32,438	$ 35,451
	Load Factor 25 Per Cent.-Steam Saturated									
Cost per kw.-hr. operating, cents	4.24	4.75	5.07	5.04	4.16	4.90	4.02	5.23	3.50	3.24
Cost per kw.-hr. fixed charges, cents	3.76	3.63	2.97	3.84	4.22	4.12	3.40	4.30	3.91	4.85
Cost per kw.-hr. total charges, cents	8.00	8.38	8.04	8.88	8.38	9.02	7.42	9.53	7.41	8.09
	Load Factor 50 Per Cent.-Steam Saturated									
Cost per kw.-hr. operating, cents	2.74	3.05	3.48	3.26	2.58	2.99	2.62	3.19	2.43	2.27
Cost per kw.-hr. fixed charges, cents	1.93	1.82	1.52	1.96	2.15	2.05	1.75	2.19	1.96	2.44
Cost per kw.-hr. total charges, cents	4.67	4.87	5.00	5.22	4.73	5.04	4.37	5.38	4.39	4.71
	Load Factor 75 Per Cent.-Steam Saturated									
Cost per kw.-hr. operating, cents	2.12	2.34	2.78	2.52	1.92	2.23	1.95	2.40	1.79	1.67
Cost per kw.-hr. fixed charges, cents	1.28	1.21	1.01	1.31	1.44	1.37	1.17	1.46	1.30	1.61
Cost per kw.-hr. total charges, cents	3.40	3.55	3.79	3.83	3.36	3.60	3.12	3.86	3.09	3.28

*Real estate, 2500; switchboards and street lighting transformers, 6500; electric wiring and ducts, 3500; oil filters and tanks, 1600; railroad siding, 3200; feed water heater, 900; feed pumps, 1500; steel stacks and flues, 1800.

**Real estate, switchboards, wiring and oil filters same as for steam plants; motor-driven cooling-water pump, 900; 10,000-gal. fuel oil storage tank, 2800; air compressor and tank, 2500; circulating-water intake, 1200; railroad siding, 1500.

Brine Temperature Affects Refrigeration Capacity

How much increase in capacity can be obtained in a 100-t. raw water ice plant using standard 400-lb. cans and requiring 11 cans per t. of ice by lowering the brine temperature from 16 to 12 deg. F.? E. J. S.

A. The actual freezing time, other factors remaining equal, is proportional to the temperature of the brine below 32 deg. F. minus the temperature of the water in the can. In the problem, the original temperature difference is 32 — 16 = 16 deg. F. Under the new conditions, the temperature difference is 32 — 12 = 20 deg. F. The new capacity will be, therefore, 20 ÷16 × 100 = 125 t. per 24 hr.

The question of cans required has been introduced in this problem. The empirical equation for actual freezing time usually given as: $F = (7 \times th^2) \div (32 = t_b)$ Where F = freezing time, th. = thickness of ice block, and t_b = brine temperature.

For present day circulation methods this equation gives somewhat high results. Probably $F = (6 \times th^2) \div (32 - t_b)$ more nearly approaches present day practice.

Using this formula for the 100-t. plant, for 11-in. blocks of ice, we have by old formula: $F = (7 \times 11^2) \div (32 - 16) = 53$ hr. By new formula, we have $F = (6 \times 11^2) \div (32 - 16) = 45\frac{1}{2}$ hr.

For the plant operating at 125 t. capacity we would have by old formula: $F = (7 \times 11^2) \div (32 - 12) = 42\frac{1}{2}$ hr. By new formula: $F = (6 \times 11^2) \div (32 - 12) = 36\frac{1}{2}$ hr. For the 400 lb.-can size, it is usual practice to divide the freezing time by 4.8 in order to determine the number of cans. This would give the following: For the old formula 100-t. condition 53 ÷ 4.8 = 11 cans; for the new formula 100-t. condition 45.5 ÷ 4.8 = 10 cans; for the old formula 125-t. condition 42.5 ÷ 4.8 = 9 cans; for the new formula 125-t. condition 36.5 ÷ 4.8 = 8 cans.

Pipe Surface Required to Refrigerate Brine

WHAT IS THE necessary pipe surface to refrigerate the brine, using 1.5 t. refrigeration per t. of ice, in a raw water ice-making tank whose brine is at 15 deg. and whose capacity is 60 t. per 24 hr. and back pressure, 15 lb.? E. J. S.

A. Capacity of tank: 60 t. of ice per 24 hr., by this problem, will require 1.5 × 60 = 90 t. of refrigeration per 24 hr. Temperature of brine is 15 deg. F. The low-pressure side is at 15 lb. g., which, from Bureau of Standard Properties of Saturated Ammonia, gives a temperature of —1 deg. F. The temperature difference between the inside and outside of the pipe coils will be 15 — (—1) = 16 deg. F.

If the system is dry, the average heat transfer rate will be probably 15 B.t.u. per sq. ft. of pipe surface per deg. difference in temperature inside and outside the ammonia coils per hr. 15 × 16 = 240 B.t.u. per hr. per sq. ft. of pipe surface. This is the heat taken up by the coils. Since one ton of refrigeration equals the removal of 12,000 B.t.u. per hr. then the amount of heat that must be taken up per hour for 90 t. of refrigeration will be 90 × 12,000, or 1,080,000 B.t.u. If each square foot will take up 240 B.t.u., it will require 1,080,000 ÷ 240 =4500 sq. ft. of pipe.

If a flooded system is used, a heat transfer rate of 25 B.t.u. per sq. ft. per hr. per deg. difference in temperature can be realized. Under these conditions, each square foot would take up 25 × 16 = 400 B.t.u. The pipe required will then be 1,080,000 ÷ 400 = 2700 sq. ft.

Saving by Use of Better Cold Storage Insulation

IT COSTS 70 cents, including overhead, fuel and labor, to produce 1 t. of refrigeration in a plant in which there is a cold storage building 40 × 40 × 40 ft. which is maintained at a temperature of 12 deg. F. Insulation is 6-in. dry shavings. The average outside temperature during 30 days is 77 deg. How much money would be saved by using 6-in. pure corkboard, using K = 3.5 for 6-in. shavings and k = 1.5 for 6-in. pure cork board? E. J. S.

A. There are several questions involved in this problem. First, is it to be assumed that the floors as well as the sides and ceiling are to be insulated with this material? Secondly, nearly every author of texts on refrigeration uses the letter K to stand for different values. To make this problem workable, we will assume this storage to be insulated on all four sides, floor and ceiling. We will assume that the values given of K are the total B.t.u.'s radiated per sq. ft. per 24 hr. per deg. difference of temperature of inside and outside storage house walls, this value representing the entire thickness and not unit thickness.

While this heat loss is really a composite value, it is also dependent, in its ratios, upon the other materials making up the walls. For present purposes, this effect will be ignored in these computations for lack of additional data.

A. Wall area 4 × 40 × 40 = 6400 sq. ft. Floor and ceiling area 2 × 40 × 40 = 3200 sq. ft. Total of radiating area = 6400 + 3200 = 9600 sq. ft.

Heat loss in 30 days by use of shaving insulated walls. Heat loss = wall area × K × temperature difference × days = 9600 × 3.5 × 65 × 30 = 65,520,000 B.t.u. Heat loss in tons of refrigeration = 65,520,000 B.t.u. Total B.t.u. ÷ 288,000 = 65,520,000 ÷ 288,000 = 228 t. of refrigeration.

Heat loss in 30 days by use of cork board insulated walls. Heat loss = 9600 × 1.5 ×65 × 30 = 28,080,000 B.t.u. in 30 days. Heat loss in tons of refrigeration = 28,080,000 ÷ 288,000 = 91.5 t.

Money saved by corkboard insulation: 227.5 — 97.5 = 130 t. of refrigeration saved in 30 days. Average cost of refrigeration, $0.70. Money saved = 0.70 × 130 = $91.00 in 30 days.

Boiler Efficiency and Life

IF YOU HAD a 72-in. boiler and 42-in. boiler both of same material, carrying the same pressure and working under the same conditions, which would give the better service and which, last the longer? J. E. T.

A. Judgment cannot be given on the relative merits of the two boilers mentioned because this depends upon the amount of load the boilers are carrying. A boiler will give best service if it is operated at its rated capacity provided, of course, that it was properly designed for that capacity. The limit of capacity will depend more upon the furnace design and draft conditions than upon the boiler proper.

The boiler will last longest if operated at rated capacity and if the boiler water does not deposit materials which act corrosively upon the metal or cause embrittlement. The life of boilers is often assumed at from 30 to 50 yr. Much depends upon how they are operated. If operated continuously at much above rating, the life of the boiler would be reduced.

If, therefore, both boilers were operating at the rated capacity of the 42-in. boiler, the smaller boiler would be operating more efficiently than the larger one. If both were operating at the rated capacity of the larger boiler, provided draft and other conditions permitted the smaller boiler to operate so much above rating, the larger boiler would be operating the more efficiently. If each boiler is operated at its own proper rating, there should be no material difference in the efficiency of operation.

Boiler Blow Down

OUR BOILER is operated 10 hr. a day with little make-up and practically no scale or dirt. When is the proper time to blow down, during the day when we have a full head of steam or before firing up in the morning when we still have from 20 to 40 lb. of steam left from the previous day?

C. E. D.

A. The best time to blow down a boiler is after the boiler has been standing idle for some time so that the water has had time to settle. It is best, therefore, to blow down before firing up in the morning.

ANY GAS that is not ordinarily a liquid at ordinary temperatures may be used as a refrigerant in commercial refrigerating machines.

Editorial Comment

How Does Noise Affect the Power Plant Engineer?

During the past few months, industry has been paying considerable attention to the effect of noise on the efficiency of workers of various kinds. Donald A. Laird and other scientists have been presenting some interesting data on the subject, the invention of the audiometer by the Bell Laboratories about two years ago having given a means of determining noise intensities. Before considering power plant noises in particular, let us observe some of the effects of noise in general as determined by this instrument.

The audiometer measures noise intensities on a scale from 0 to 100, a just inaudible intensity as 0 and an intensity that makes the ear drum of a normal ear tingle on the verge of pain as 100. It is found, on this basis, that few people work in places where the intensity is less than 50. Street noises often reach 60 or 70. In a closed room, with no noise being made in the room, the intensity was 25, increased instantly to 35 by opening a window half way. Some factory operations subject workers to a continuous noise intensity of 85 units.

In experiments on typists, it was found that, when the noise in the test chamber was decreased only 15 per cent, there was a 5 per cent increase in output and a decrease of 25 per cent in the amount of energy consumed in typing. The original noise, however, must have been just above the critical point, because further reduction seemed to produce little effect on either output or energy consumption.

Now noise of machinery in a power plant is somewhat different from that noted above and considerable doubt exists as to whether or not it has deleterious effects on human beings. As a matter of fact, operators of generating units get so accustomed to the characteristic hum of a given generator or the roar of a large turbine that they are aware of the sound only when it changes in character. The characteristic noise of the machine is an aid in operating it. This is particularly true in the operation of Corliss engines, for example, which have characteristic sounds caused by the valve gear.

But in the control room of a large plant, especially a central station, conditions are different. This room is often located so that it looks out over the turbine room. Here the control operators are in direct telephone communication with load dispatchers, system operators, officials of the company and so on. Important operating records, incorporating meter readings and other data, are often made in this room. Here is a place where a background of noise or vibration may cause trouble, by making telephone conversations difficult, with resulting possibility of errors in giving or receiving orders, or by producing a generally uncomfortable feeling of nervous tension in the room. In short, we scarcely need a test of any kind to tell us that the control or operating room is a place where quiet will really make a difference to the men working there.

This fact was recognized in the rebuilding of the San Francisquito No. 2 hydroelectric plant and special precautions were taken to prevent noise from entering the control room. How this was done is described in this issue by Clayton M. Allen. It is believed that this is the first application of acoustical treatment in power plants and it surely merits attention by plant designers.

Certainly, in the case of a new plant, the construction features described by Mr. Allen would be little more expensive than other types. More important than this, if a noisy operating room lowers the operators' efficiency, it would be the part of wise human engineering to eliminate the noise. Here is one interesting solution of the problem.

Standardization

While retailers and manufacturers are forging slowly ahead with standardization plans, eliminating unprofitable lines from their shelves and warehouses, cutting down on large stocks and eliminating special orders which tend to interfere with quantity production the electrical industry can look back with satisfaction on a standardization fight well fought.

It was not so many years ago that frequencies and voltages of electric circuits were the subjects of heated controversies. Although a few districts still stand by direct current, a few plants or systems still use 25 and 50-cycle equipment and here and there in odd corners of the country an odd voltage creeps in, 60 cycle alternating current, at voltages of 110, 220, 440 and 2200 and 13,600 is almost universal practice and is no doubt largely responsible for the rapid growth of interconnection and electrification of industry.

Much remains to be done in the mechanical end, however, for, although some progress in standardization of auxiliaries has been made, prime mover and boiler designs are far from uniform, each new station bringing forth increased demands for special equipment.

Uncertain conditions in the pressure field leaves the designer at liberty to select practically any pressure he desires or which best meets his particular condition. There does, however, seem to be little reason for the array of pressures which are used, increasing in 15 or 20-lb. increments.

Advantages of a few standardized pressures such as perhaps 250, 400, 600, 900 and 1400 lb. should be of great advantage both to manufacturer and designer and should be sufficient to more than balance any slight thermal loss resulting from departing a few pounds one way or the other from a pressure which appears best from a theoretical standpoint.

Off Duty

Nature, by virtue of the peculiar mechanics of the solar system, has provided mankind with two general divisions of time consciousness—day and night. In these divisions, we must live whether we care to or not and for us, here, 92,000,000 miles away from the dynamic center of our system, it is well that we have these divisions for upon them depends our very existence. It is inconceivable with our present understanding of life processes that life could exist on earth had the rotational motion of the earth on its axis been forgotten or greatly modified.

Both (day and night) being so necessary to our existence, it is strange that mankind in general should have come to regard one as superior to the other. For we believe we are correct in our contention that most people prefer, or think they prefer, day to night. Night, it seems, is only a time to sleep—to lose consciousness until another day appears. Much evidence could be introduced here to support this contention but it will be deemed sufficient merely to quote the classic maxim from Poor Richard, "Early to bed, early to rise, makes—" well, you know the rest.

Perhaps Franklin wrote that, perhaps he didn't; if he did, he may have had his tongue in his cheek. This much is certain, Ben, if he believed it, didn't practice it much himself, for he accomplished too much and left too much wisdom behind him to have done so. He was entirely too civilized.

True, early to bed, early to rise may very well lead to health and health in some instances may lead to wealth but as to making one wise, well, that is quite a difference matter. For wisdom, history shows, is not always the product of healthy bodies. Some of the greatest geniuses mentally, have had pitifully unsound bodies; many of the greatest achievements of the human mind were created by those whose entire lives were fraught with disease and ill health.

No, wisdom is a matter entirely apart from health and if anything is to be said on the subject, it is that wisdom is more often born in the stillness of the night than it is in the clamor and turmoil of day. The mind works better in the quiet and sereneness of the hours around midnight when the flow of thought is unbroken by any disturbing influences. The mind is more alert at these hours and things present themselves in a calmer, clearer light than at other times. Our understanding of things is better and in times of stress or when under great emotion, we find reasons for hope at such times where none could be seen before. If you are confronted by difficult problems, try staying up late at night to solve them.

This isn't written in support of the night clubs and wild parties, for there is precious little wisdom to be found in such activities; but, oddly enough, what is true in this respect about wisdom is also true about our enjoyment and pleasures in life.

Our happiest hours are those which come after dark; after the day's work is over and the cares of providing for our existence are set aside. The daylight hours portray the world in grim reality, in harsh contrasting colors and hide none of the stern necessities. Night, on the other hand, brings mystery—romance; the harsh tones of the day fade into softness, giving our imaginations chance to play.

Then, if you pick your nights well, there is moonlight—moonlight which brings romance and beauty. Just what peculiar quality that makes moonlight do the things it does, the way in which it affects our mental processes and emotions and how it affects our appreciation of beauty is a problem which philosophers and scientists can spend their lives at and never solve but the fact that moonlight penetrates deeply into the human soul always remains. Things are different by moonlight—they don't look the same as they do during the day. It paints familiar things in a mysterious and alluring fashion. The most ordinary streets, the most sordid river front, the most prosaic power plant in the strange whiteness of moonlight becomes possessed of a haunting sort of beauty. Moonlight hides all the defects and enhances the beauty of everything it touches. This is only another way of saying that things look prettier by moonlight than they do otherwise.

So, if you would enjoy beauty, go out by moonlight. In the calm stillness of the night, the world will take on a kind of beauty that will bring contentment. Your worries will diminish.

Music too is better by moonlight, particularly if there is water. Many a man has said more than he intended while under the enchantment of a tinkling guitar on a moonlit bay.

There is a mysterious something about the night that the day never can bring. Life at night can be beautiful—during the day it is a struggle. To our existence, what we do between sunrise and sunset is important; but to our minds and to our enjoyment of life, what we do between sunset and sunrise is vastly more important.

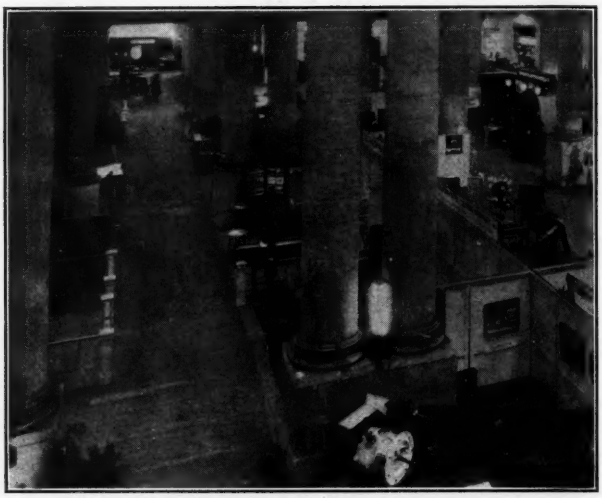
Night life is essentially a product of civilization. The more civilized a people becomes, the more enjoyable is its night life. Primitive man, like animals, had little use for night time. Engaged in the hard struggle for existence all day, darkness to him was only a time to cease activity and having nothing further with which to occupy himself, he slept. As he advanced in intellect, as through successive generations he acquired a background of culture he found that night time time offered an opportunity to satisfy his instinctive desire to live a fuller life. So social intercourse developed. At night, around the fireside, the art of conversation first made its beginning. Ours, says Baker Brownell, is an igneous civilization scented with smoke and burning.

It is in the cities that the art of living at night reaches its highest development. There, among kindred spirits, in an atmosphere conducive to the development of the aesthetic sense, man has learned to enjoy himself at night, often to the bitter resentment of the reformers, who can little countenance the pleasure of others. The more civilized the city, the more intense is its night life.

Think it over. Perhaps you don't agree with this theory and if you don't that's your privilege. But don't denounce it without reason. Try staying up late at night once in a while while Luna is flooding the countryside with her silvery lustre. Try reading a book when all the rest of the family have retired. What book? It doesn't matter—anything that strikes your fancy. If you have nothing else, read Power Plant Engineering. If you find that it fails to interest you—well, you can always go to bed.

PRODUCER *AND* CONSUMER TO MEET HERE

Power Show at Grand Central Palace, New York, Dec. 2 to 7



IN PERICLES' TIME, an Athenian flour mill ground out about two barrels of flour a day; modern Minneapolis mills grind 20,000 bbl. in the same space of time. Prior to the invention of the condensing steam engine, a blacksmith forged a hundred weight of iron between sunrise and sunset; today a throttle is thrown and steel muscles roll hundreds of tons of ingots into rails, rods and structural shapes in 8 hr.

During the last decade, the modernizing of methods has set a pace for the keenest scientific minds in the industry, typifying the American spirit of pushing forward, reaching, climbing, and planning for the years to come.

This phenomenal progress will be summarized during the week of December 2, when three floors of exhibits covering 130,000 sq. ft. will give a picture of progress in power plant equipment at the National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

For the eighth consecutive year the National Power Show will bring together inventions and improvements developed for producing power at the minimum cost and will attract the leaders of thought and action from all parts of the country. At last year's exposition, the attendance of 118,000 included engineers, industrial executives and plant operators, among whom were 300 visitors from foreign countries. As a clearing house for the latest information relating to important developments in power and mechanical engineering, I. D. Moultrop, of the Edison Electric Illuminating Co., Boston, says, "This is a serious exposition for serious-minded people. There are a number of unusual and interesting displays, some of which will find their way into power plants throughout the world very shortly."

Covered by the exhibit will be new developments and inventions, new processes and ideas which have been forthcoming during the past year, also improvements on old principles and, of course, the engineering staples which are the ground work of standard practice. To explain and demonstrate the exhibits, the best experts in their various lines will be in charge of booths and here can be obtained invaluable information and advice as to the use of the equipment exhibited for the equipment of power plants and the rehabilitation which is so necessary to keep them in the most economical operating condition.

During the week of the exhibit, the American Society of Refrigerating Engineers will hold its annual meeting, also the American Society of Mechanical Engineers, thus bringing to New York a large group of well-known authorities in the field of power generation and utilization.

In the following pages will be found descriptions of the various exhibits to be found in the various booths, all conveniently reached by means of the elevated or subway on the east side of New York, or from the west side by crossing over at 42nd St. The Grand Central Palace, located between 46th and 47th Sts. on Lexington Ave. will be open from noon until eleven o'clock each day beginning December 2nd and closing December 7th. Three floors will be completely occupied by the exhibits, the arrangement of booths being shown in plans herewith.

Each visitor to the exposition will have his own individual problems on which he wishes enlightenment and will of course be interested in equipment applicable to conditions in his plant. By studying the descriptions of exhibits, it will be easy to determine which of these would seem to him of most immediate interest and the trip can be planned to cover these carefully, not omitting, however, to give inspection to all the exhibits, since all of them will have features of interest to everyone connected with the power plant industry.

By making a schedule for each day, the visitor can be sure to cover the ground in thorough fashion and, by noting down in advance information especially desired, this will be obtained when talking with those experienced in that particular branch of the industry. By using a notebook laid out beforehand to cover these points and which will, of course, gather much information, not only on the points planned, but on many other matters, one will have a permanent record for reference which will be found of the greatest help. Also, this will give a place where names and addresses wanted for future correspondence can be preserved without danger of losing them as is the case where stray cards and memoranda on the backs of envelopes are depended upon.

Cheaper power invites competition. If your competitors' power costs are lower than yours, you are at a disadvantage. The converse is also true. Cheap power is largely a matter of control. If equipment is out of date, you cannot expect to compete with a plant which is up to the minute.

Ideas are contagious and wise men expose themselves. In other words, the successful man is a germ carrier. His favorite germs are opportunity and advancement. He seeks all opportunities to learn what others in his field are doing, thinking, and saying, to meet men with active, alert minds.

At the Power Show, you may step right up and talk to the man who knows what he is talking about.

Directory of Exhibits

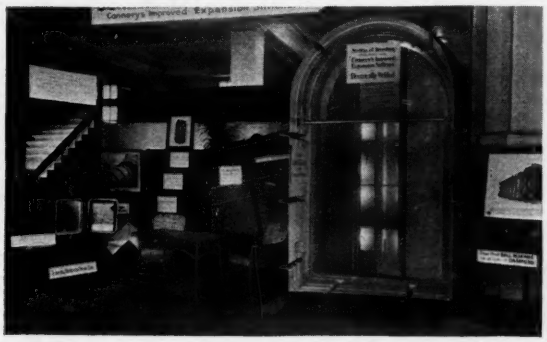
Absolute Con-Tac-Tor Corp.,
Elkhart, Ind. Booths 306, 307

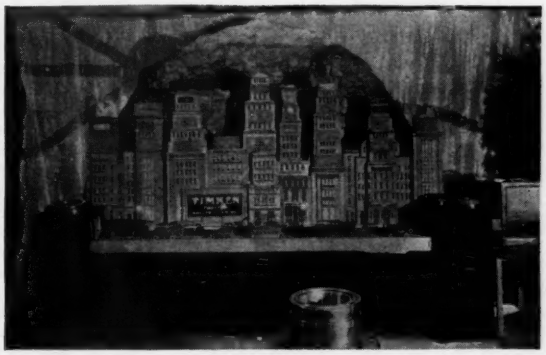
Advance Engineering Co., Booths 272-4
168 Washington St., New York, N. Y.

considerable demonstration will be given of the characteristics and the application of this type to motor starting. Several new products will be displayed, among them

John Deutsch, vice-president; D. W. Simler, New York.

Allis-Chalmers Mfg. Co., Booths 515-17
Milwaukee, Wisc.





Alexander Brothers, Inc., Booths 269, 270
14 South St., Philadelphia, Pa.

Efficiency of Tentacular transmission belt will be shown under normal operating conditions as well as the features of construction and the methods of application of Tentacular belts for all classes of belt transmission.

Representative: J. L. deRabot, consulting engineer.

Allen Air Appliance Co., Inc.,
Booths 241-3
452 Lexington Ave., New York, N. Y.

Products to be exhibited here will include the Triple A products, heavy duty pneumatic sweeping systems for factories and power plants, single and multistage centrifugal or turbo blowers and exhausters, heavy duty portable vacuum cleaners for industrial service. As a special feature will be found the heavy duty industrial type pneumatic sweeping system in actual operation to demonstrate the power and capacity of these machines by means of visible action. A new product will be a recently designed 2-hp. portable vacuum cleaner for industrial service, showing the small size and compactness.

Representatives: L. B. Hardtla, sales manager; E. J. McEwen, William Fawcett, I. H. Russell, R. J. Heller, E. Failmezger, I. E. Bickhart, E. H. Parker.

Allen-Bradley Co., Booths 558-60
Milwaukee, Wisc.

A general line of alternating and direct current, automatic and hand-operated motor starting equipment will be displayed here. These devices utilize the graphite compression resistance principle and con-

an oil burner control panel and an overload protective relay for small motors, a line of standard across-the-line starters with disconnect switches, small contactors of use for hundreds of different purposes and ruggedly built to withstand service similar to traffic signal operation.

Representatives: F. F. Loock, general sales manager; G. O. Wilms, chief engineer; W. B. Neeper, assistant chief engineer; C. N. Calkins, manager New York office; M. H. Hallenbeck, manager Boston office; G. F. Pain, manager Philadelphia office; P. R. Streeter, H. I. Search, New York; A. F. Landergott, Philadelphia.

Allen Mfg. Co., Booth A, Mezz. Fl.
133 Sheldon St., Hartford, Conn.

Allen & Billmyre Co., Inc., Booths 457, 458
Grand Central Palace, New York, N. Y.

Specialties for blowing, exhausting and vacuum cleaning will be shown here, including centrifugal blowers and exhaust fans, industrial vacuum cleaning systems and pneumatic conveyors.

Representatives: J. F. Billmyre, president; S. D. Barr, sales manager; A. Weiss, J. S. Tyrell.

Allen-Sherman-Hoff Co., Booths 62, 63
225 S. 15th St., Philadelphia, Pa.

This company will have a scene-in-action display demonstrating the operation of the Hydrojet system of ash removal, also an ash pump, newly developed this year, cut away to show the operating parts. Allen - Sherman - Hoff soot valves will be shown.

Representatives: F. B. Allen, president;

Allpax Co., Booth 608
Mamaroneck, N. Y.

Allpax packing in coil and loose forms will be shown illustrating the combination of long asbestos fibre and graphite flakes which results in a resilient packing with a lubricating surface, to stop leaks and eliminate scoring of rods or shafts.

Representatives: O. H. Funk, sales manager; Charles H. Davis, E. Goodrich, E. E. Edgecumbe, William A. Harris.

American Arch Co., Inc., Booth 58
17 E. 42nd St., New York, N. Y.

American Blower Corp.,
Booths 314, 315, 321, 322
6000 Russell St., Detroit, Mich.

All types of unit heaters, Ventura-fin, Sirocco and Universal, will be shown, several of these being connected with electrical current in order that the visitor may operate them himself and see how hot air can be forced into definite areas. A Universal unit with balloons to denote action of air will also be displayed. New type Sirocco units and the new Ventura-fin unit heater are features and improvements shown for the first time.

Representatives: A. Ritter, H. Barth, T. L. Kennedy, J. F. Munder, E. A. Bennett, J. S. Billig, E. W. Legier, J. B. Leonard.

American Brass Co., Booth 65
Waterbury, Conn.

Admiralty and Ambrac condenser tubes, condenser head plates, Everdur metal, Anaconda welding rods, brass pipe and copper tubes for use with compression fittings, extruded shapes, die-pressed parts, rods, bars and segments, Anaconda sheet

metal will constitute the exhibit in this space. Specially featured will be the application of these various materials to power plant equipment and apparatus.

Representative: W. Harold Dowd, in charge.

American Car & Foundry Co., Booth 201
30 Church St., New York, N. Y.

Berwick electric rivet and metal heaters will make up this exhibit, their economy and convenience being demonstrated.

Representatives: F. C. Chesterton, John S. Helt.

American Gas Assn., Inc., Booth 7
130 E. 15th St., New York, N. Y.

American Mason Safety Tread Co.,
Lowell, Mass. Booth 432

Products shown here will be the Mason safety tread products for structural stairways, runways and floors of industrial plants, also structural stairways for power plants and the carbo-cast tread for power plants.

Representatives: William A. Lamson, treasurer; Harold A. Welcome, vice president and general manager; Milton O. Lange, James H. Doyle.

American Metal Hose Co., Booth 291
Waterbury, Conn.

Flexible metal hose, metal tubing and metal conduit will be shown in a complete line, also various special types for special use in the industrial field, including the most recent developments of this product.

Representatives: John E. Locke, assistant secretary and assistant treasurer, in charge of exhibit; John K. Pratt, Everett B. Merriam, Arthur W. Cook.

American Pipe Bending Machine Co., Inc., Booth 640
37 Pearl St., Boston, Mass.

Two new bending machines will be displayed, one being a power-operated bender of 2-in. capacity and the other for bending thin tubing to a radius of about twice the diameter of the tube itself.

Representatives: E. P. Blake, sales manager; Nelson J. Pepin.

American Radiator Co., Booth 544
40 West 40th St., New York, N. Y.

Automatic temperature and pressure controls, motor-operated valves and solenoid valves will be shown. Dual pressure and temperature controls will be especially featured, also a dual unit heater control and improved motor operated valve and a combination low water cut-off and pressure control.

Representatives: K. B. Thorndike, F. S. Bartlett, R. S. Dawson, R. L. Campbell.

American Schaeffer & Budenberg Corp.,
338 Berry St., Brooklyn, N. Y. Booth 60

This company, which is a branch of the Consolidated Ashcroft Hancock Co., Inc., will display recording and indicating thermometers, gages, safety and water relief valves, Hancock bronze cast steel and forged steel valves and a new power control valve.

Representative: W. P. Bradbury, general sales manager, in charge.

Ames Pump Co., Inc., Booths 417, 418
30 Church St., New York, N. Y.

Appleton Electric Co., Booth 507
1701 Wellington Ave., Chicago, Ill.

Products shown in this exhibit will be Unilets, of no-thread and threaded types, Reelites, constant duty Reelites and other electrical specialties.

Representatives: Messrs. Ingald, Flandreau, Park, Chambers and Swick.

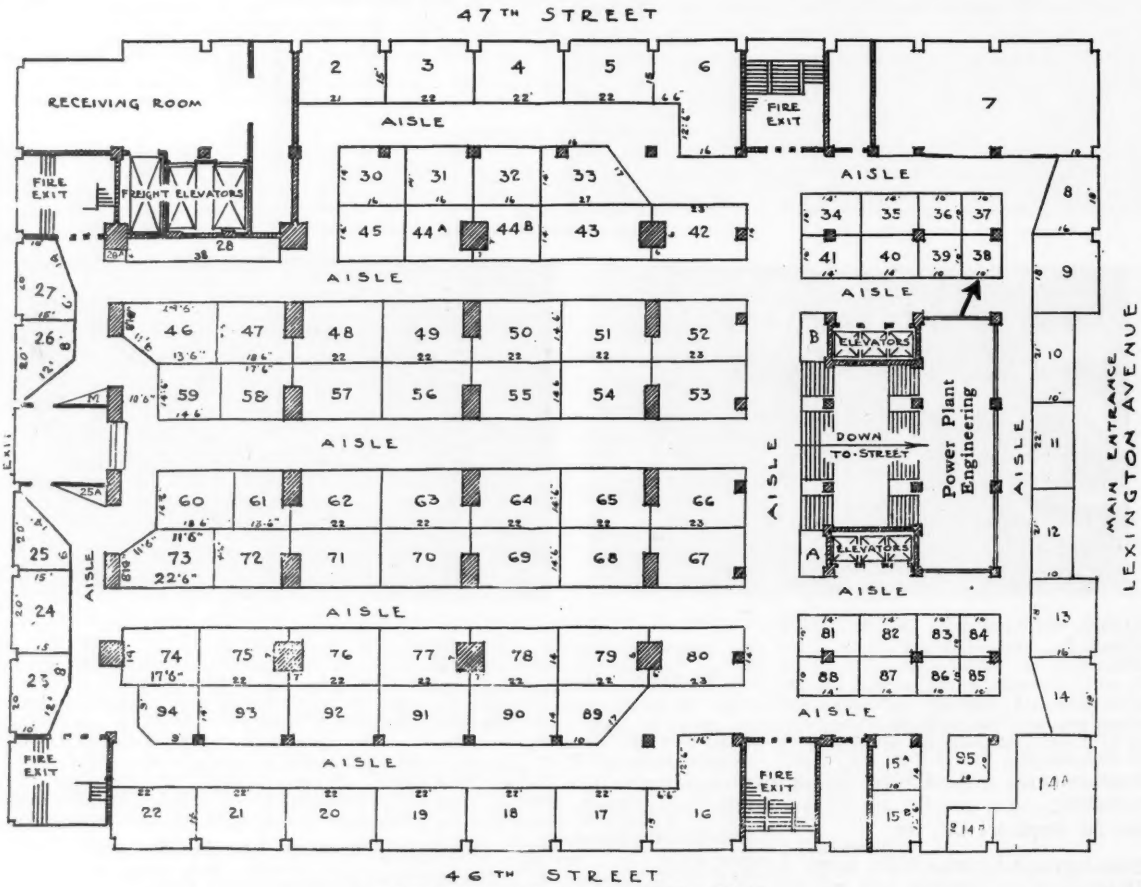
Armstrong Cork & Insulation Co.,
Lancaster, Pa. Booths 342, 343

Armstrong insulating brick for furnaces, boiler settings, kilns and other heated equipment will be shown here, this material being for temperatures above 1600 deg. F. Nonpareil insulating brick for temperatures lower than that will also be shown, as well as corkboard for cold storage rooms and walls and roofs of buildings. Insulating blocks for power plant auxiliaries, ovens and similar equipment at medium temperatures, also machine isolation for absorbing and deadening the sound of moving machines will be featured.

Representatives: Sloane Martin, J. F. Isaacs, H. B. Gates, E. C. Maxson, A. B. Alexander, E. W. McDougal, E. C. Hawley, C. A. Senter, R. S. Broas, A. E. Pearce, A. P. Tingle, G. R. Plender, C. E. Betts.

Armstrong Machine Works, Booth 271
Three Rivers, Mich.

Armstrong steam traps, as manufactured by this company, will be exhibited in a complete line as well as the standard cast iron trap, forged steel trap for high pressures and compound steam traps for



PLAN OF MAIN FLOOR BOOTHS 2 TO 95

handling large quantities of water at high pressures. The company will also exhibit a glass model of the Armstrong trap operating on steam pressure, showing the entire cycle of operation of the inverted submerged-bucket, body as well as bucket being of glass. The quick action of the valve and self-scrubbing action of the trap will be evident.

Representatives: A. E. Armstrong, president; T. H. Rea, sales manager; O. E. Ulrich, factory representative.

Ashton Valve Co., Booth 38
161 First St., Cambridge, Boston, Mass.

Pop safety and relief valves, indicating and recording pressure and vacuum gages, master pilot pressure gages with illuminated dials, dead-weight gage testers and kindred instruments will make up the display. Special features will be the style CSH cast steel high pressure pop safety valve with plug type top or blowdown control and a 100-A Master pilot pressure gage with double illuminated dial; also No. 79 double area dead-weight gage tester.

Representatives: H. H. Ashton, sales manager; Charles W. Buckelew, New York manager; C. W. Ulrick, W. E. Gilmore, Claude J. Burrage.

Atwood & Morrill Co., Booths 552, 553
Salem, Mass.

Bleeder valves, condensate traps and equipment for bleeder heater work will be found in this exhibit. The main feature will be an oil closing bleeder valve which has been devised for one of the leading turbine manufacturers of the country.

Representatives: B. T. Atwood, secretary, in charge; John Leggett, Linwood Kimball, Alec Hose.

Automatic Switch Co., Booth 551
154 Grand St., New York, N. Y.

Products of this company's manufacture, including solenoid valves, automatic transfer switches, remote control switches and heavy duty relays and contactors, will be shown. One of the main features will be the new form S valve, made for ½ to 12-in. pipe sizes and designed for the control of high pressures.

Representatives: W. F. Hurlburt, Louis Schwab, C. W. Valentine.

Babcock & Wilcox Co., Booth 55
85 Liberty St., New York, N. Y.

Sections of forged steel headers for pressures up to 1450 lb., special forged steel drum nozzles of various designs and specimens of B. & W. welding practice will be included in this exhibit. Sections of latest designs in superheaters and fuel economizers will be shown. Of great interest will be a sectional model to ⅛ actual size of a Babcock & Wilcox cross-drum boiler with superheater, air heater, economizer, Bailey furnace walls and equipped with Westinghouse stoker. This model, 10 ft. high, is to form part of a permanent exhibit at the Smithsonian Institute, Washington, D. C. Other products of the company will be refractories, including fire brick shapes, cement and plastics, also steel tubes, Enduro and Toncan iron tubes and pipe.

Representatives: Hosea Webster, P. C. Idell, W. E. Sparrow, Jr., L. P. MacFarlane, W. W. Eaton, J. E. Brinckerhoff.

E. B. Badger & Sons Co., Booths 565, 566
Boston, Mass.

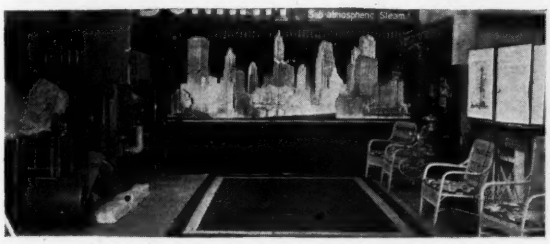
This company's exhibit will contain various types of expansion joints such as the Badger self-equalizing in both flanged and welding types, also the single and multiple-corrugation low-pressure expansion joints. A special feature will be a copper hot water storage tank.

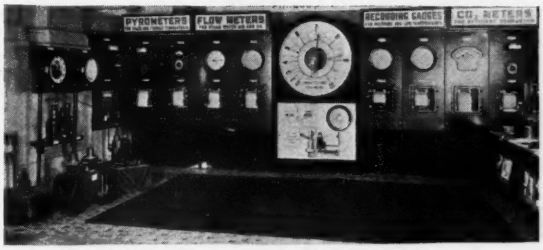
Representatives: H. W. Coombs, sales manager; F. R. Heath, A. R. Lawrence, F. E. Lyons, W. R. Styles.

Bailey Meter Co., Booth 51
1050 Ivanhoe Rd., Cleveland, Ohio

Products displayed in this booth will be Bailey automatic control as applied to the operation of steam boilers and to the maintenance of various factors in process work; thermo-hydraulic feedwater regulators and pump governors; mechanically and electrically operated fluid meters for the measurement of steam, water, gas, air and other fluids; Selsyn-operated devices for long distance transmission of pressure, temperature, draft, liquid level, motion, speed and other readings. Special features of this exhibit will be a long distance type Selsyn-operated liquid level recorder and indicator in operation, a meter control drive cut away to show the operation of solenoid-operated clutches, time limits, travel limits and other features; also a large display of photographs, layouts and records from actual installations of meter control. Several new products will be shown, among which are the Selsyn-operated devices, thermo-hydraulic feedwater regulators and pump governors. Features of the feedwater regulator are a balanced, tight-seating valve with V-ports, valve cage removable for inspection without removing the valve body from the line, provision for the difference in expansion between the valve body and the cage, generator of simplified unit construction, all-metal hydraulic system proportioned so that safe pressure exists under all conditions, condensate by-pass and safety seal in the generator which prevents water difficulties. The Selsyn system is an adaptation to power plant metering of a method used for some time for direction of gun fire on battle cruisers. Actual demonstration of the liquid level recorder in use will be made.

Representatives: H. M. Hammond, general sales manager in charge; H. C. Wheaton, New York branch manager; H. C. Tanner, Philadelphia branch manager.





R. H. Baker Co., Inc., Booths 323, 324
238 Main St., Cambridge, Mass.

Photographs will be shown of recently completed steam power plants and industrial installations, showing the latest progress in piping, including the use of Tube-Turns, welded pipe lines, lap jointed extra heavy brass pipe, and other specialties.

Representatives: Rowland Tompkins, New York manager, in charge; W. E. G. Lucas.

Baldwin Chain & Mfg. Co., Booth 509
Worcester, Mass.

Products to be shown here include machine finished steel roller chains, block chains, replacement chains and sprockets for power transmission and conveying of materials. There will be a moving power exhibit as well as display boards of the various products.

Representative: L. Clifton Havener.

Ballwood Co., Booths 221, 222
30 Church St., New York, N. Y.

Barco Manufacturing Co., Booth 247
1801 Winnemac Ave., Chicago, Ill.

Lubricated plug valves and flexible joints will be shown here, with electrically-operated working models of the joints as a special feature. Also, in new designs, will be the Type LCI and MCI lubricated plug valves for three or four-way operation and with lubricants forced in through the stem of the plug.

Representatives: A. S. Lewis, New York district manager; R. P. Klein.

Barnes & Jones Booths 312, 313
128 Brookside Ave., Jamaica Plain, Boston, Mass.

Air eliminators for steam and vacuum heating systems, also complete systems for heating by hot water, vacuum or vapor will be main features of the exhibit. Traps of all classes will also be shown, including expansion and thermostatic type and those suitable for heating boiler return. Air vents for heating systems and radiator valves of various types, including modulating, packless and return line valves will be on display.

Representatives: Walter E. Barnes, William T. Jones, H. B. Eells.

Bauer & Black, Booths 522, 523
2500 S. Dearborn St., Chicago, Ill.

First aid supplies including adhesive plaster, bandages, plain gauze, sterile cotton, hospital cotton, handy tape dressings, first aid kits and cabinets will be found here. The main features of the exhibit will be the new gauze bandage with non-ravel edge and a display of zinc oxide adhesive plaster cut in any width desired by the purchaser. The Uniflex first aid kits for public utilities will be prominently displayed.

Representatives: C. H. Sigler, divisional sales manager; H. R. Hall, J. R. Strohecker, C. F. Burhard, C. Harry Jackson, William F. Jenkins.

Bausch & Lomb Optical Co. Booth 602
Rochester, N. Y.

A complete line of microscopes and accessories, microtomes and optical measuring instruments will be included in this

exhibit, including a new hydrogen ion colorimeter for pH determinations, quartz monchromator, spectrophotometric equipment, micro-projection apparatus, magnifiers, reading glasses, and other instruments of similar nature.

Representatives: Dr. Max Poser, special representative in charge; George H. Leffler, micro sales department, Rochester; E. H. Anthes, assistant manager; J. A. Scheick, P. Powell, W. A. Carter, Mason Bettis, New York office.

H. Belfield Co., Booth 550
435 N. Broad St., Philadelphia, Pa.

Steam specialties and special valves for high and low pressures will be exhibited in this space, also steel control valves and new special valves for high velocity and high temperature with steel body and stainless steel trim.

Representatives: F. R. Goehring, Thomas L. Smith.

Bernitz Furnace Appliance Co., Booth 78
89 Broad St., Boston, Mass.

Bernitz Carbofrax air-cooled blocks for boiler furnaces, also Carbofrax floor for pulverized fuel and oil burning furnaces and the Nygaard Carbofrax facing blocks for water-cooled furnace walls, will constitute the exhibit here. A typical installation will be shown of the air-cooled blocks provided with an actual air circulation to illustrate the effective cooling obtained by the Bernitz type of construction.

Representative: Arthur E. Smith, in charge of the booth.

Bethlehem Steel Co., Inc., Booths 70, 71
Bethlehem, Pa.

Bethlehem pulverizers, Dahl oil burning systems, torque amplifiers, Bethlehem pipe, engine bolt and stay bolt iron and steel will be included in the exhibit. Special features will be the pulverizer and a display of the oil burning system with their operation demonstrated.

Representatives: H. P. Pearson, Jr., R. F. Weaver, W. H. Dickey, O. A. Kreutzberg, G. A. Worn, J. P. Madden, C. W. Nieman, H. W. Nieman, W. P. Pritchard, in charge of exhibit.

Biax Flexible Shaft Co., Booth 508
20 East 17th St., New York, N. Y.

Products here shown will be flexible shafts and flexible shaft machinery, also rotary files for die work. A special feature will be the multi Biax units mainly used in finishing die moulds, core boxes, bronze and aluminum castings. Various grinders and portable flexible shaft machines for buffing, polishing, grinding and sanding will be displayed.

Representatives: R. Wezel, president; F. I. VanderBeek, vice president; G. M. VanderBeek, treasurer; H. T. Stroh, salesman.

Bigbie Grate & Forced Draft Equipment Corp., Booth 316
90 West St., New York, N. Y.

L. C. Biglow & Co., Inc., Booths 263
250 West 54th St., New York, N. Y.

Hanson Process taps, thread gages, die and thread milling hobs, worms, lead screws and other parts will be shown as "finished in the thread after hardening." Scully-Jones production tools including tap and cutter chucks, floating and self-aligning reamer holders, counterbore and spot facing tools will also be displayed as well as Davis boring tools including micrometer adjustable and block type bars and cutters, reamers, fixtures, and the like.

Representatives: W. H. Beckwith, C. W. Derr, L. C. Biglow.

Binks Manufacturing Co., Booths 632, 633
3114 Carroll Ave., Chicago, Ill.

Here will be found a model cooling tower, also a complete line of spray nozzles and accessories for cooling pond service. In addition will be shown a number of paint spraying machines especially adapted for the maintenance of power house property. The model spray cooling tower will be a special feature as it will be shown in operation and under new products will be shown the Hurley unit portable paint spray outfit.

Representatives: Neil C. Hurley, president; J. F. Roche, executive vice-president; C. R. Kranz, manager power equipment division, in charge.

Bishop Wire & Cable Corp., Booth 643
420 East 25th St., New York, N. Y.

Wire and cable will be shown here including newly developed contact cable which not only performs the function of the ordinary cable for carrying current but also makes contact at any point by pressure the same as a push button or switch. Bare wires are normally held out of contact by elastic material, pressure on the outer walls making contact and allowing current to pass.

Representative: W. J. Mundell.

Boiler Engineering Co., Booth 450
931 Federal Trust Bldg., Newark, N. J.

This exhibit will make clear the features of yielding flexible BECO boiler baffles and the effect of positive expansion joints in preventing cracking or breaks. Use of corrugated sheet metal separators and the benefits of using angular baffling in horizontal water tube boilers will be demonstrated. BECO tube blocks as used in baffle wall construction will be exhibited, also photographs of numerous installations in all kinds of water tube boilers.

Representative: J. W. Putnam.

Charles Bond Co., Booth 485
617 Arch St., Philadelphia, Pa.

Standard stock gears and two interesting moving exhibits showing their application, also a line of special tanned and of oak tanned flat belting will be displayed. Bondaron round belting will be specially featured.

Representatives: C. Carter Bond, manager; C. F. Cludins, William R. Milnor.

Bond Foundry & Machine Co., Booth 486
Manheim, Pa.

Power transmitting machinery, truck casters for industrial plants and roller bearings.

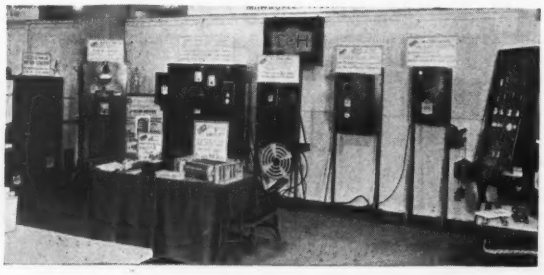
Representatives: M. M. Brown, W. E. Blauvelt.

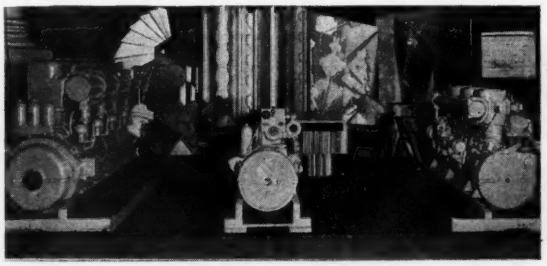
Borden Co., Booths 428, 429
Warren, Ohio.

The entire line of Beaver time and labor-saving die stocks, pipe cutters and power drives will be shown with all products demonstrated and the power drive in constant operation. It is expected that important announcement will be made at the show of new products.

Representatives: E. R. Barkley, assistant sales manager; W. J. Mitchell, New York manager.

Boston Gear Works Sales Co.
Booths 326-31
Norfolk Downs, Quincy, Mass.





Standardized gears, Renold-Boston and Duckworth-Boston chain drives, also adjustable shaft supports will be displayed. New products exhibited will include speed reducers for light duty, equipped with Timken tapered roller bearings.

Representative: H. Muller, New York sales manager.

Botfield Refractories Co., Booth 94
Swanson & Clymer Sts., Philadelphia, Pa.

All the company's line of Adaproducts will be exhibited, including Adamant fire brick cement, Adachrome fines, Adachrome aggregate and plastic supercement, Adapatch and the Adamant gun for application of plastic refractories.

Representatives: A. H. Engstrom, sales manager, in charge; W. B. Smith, C. C. Phillips, S. C. Lott, J. J. Sweeney, salesmen.

S. F. Bowser & Co., Inc.,
Fort Wayne, Ind. Booths 620, 621

This company will exhibit its standard line of lubricators, filters and other devices of similar nature.

Representative: E. M. Yentz.

Breuer Electric Mfg. Co., Booth 462
844 Blackhawk St., Chicago, Ill.

Tornado products will be displayed here, including portable electric blowers, electric sprayer for insecticides, industrial vacuum cleaner and paint sprayer. All these will be demonstrated and advantageous features illustrated. A new product to be shown will be the industrial vacuum cleaner and paint sprayer, a machine weighing only 25 lb., equipped with universal motor and arranged for cleaning equipment around a power plant. The paint sprayer weighs but little over 7 lb. and is therefore readily available for either full painting or special touching up.

Representatives: A. A. Breuer, general manager in charge; A. S. Corte.

Bristol Co., Booth 12
Waterbury, Conn.

On demonstration will be shown a complete line of indicating and recording instruments including pressure and vacuum gages, thermometers, voltmeters, ammeters, wattmeters, shunt ammeters, barometers, temperature control instruments, differential recorders and control valves. Of special interest will be the electrical instruments of improved design and models, also an air-operated draft controller.

Representative: G. H. Gaites, Philadelphia district manager.

Brooklyn Gas Co., Booth 7
Brooklyn Union Gas Co.,
Brooklyn, N. Y.

Builders Iron Foundry Booth 28
Providence, R. I.

Venturi meters, diaphragm meters, and shunt meters will be shown and their operation demonstrated.

Representatives: Messrs. Purdie, Merlo, Codell, Watjen and Hammond.

Bundy Steam Trap Co., Booth 8
39 Elm St., Nashua, N. H.

Steam traps will constitute the feature in this exhibit, a general line being shown covering all types of traps and application to all trap services.

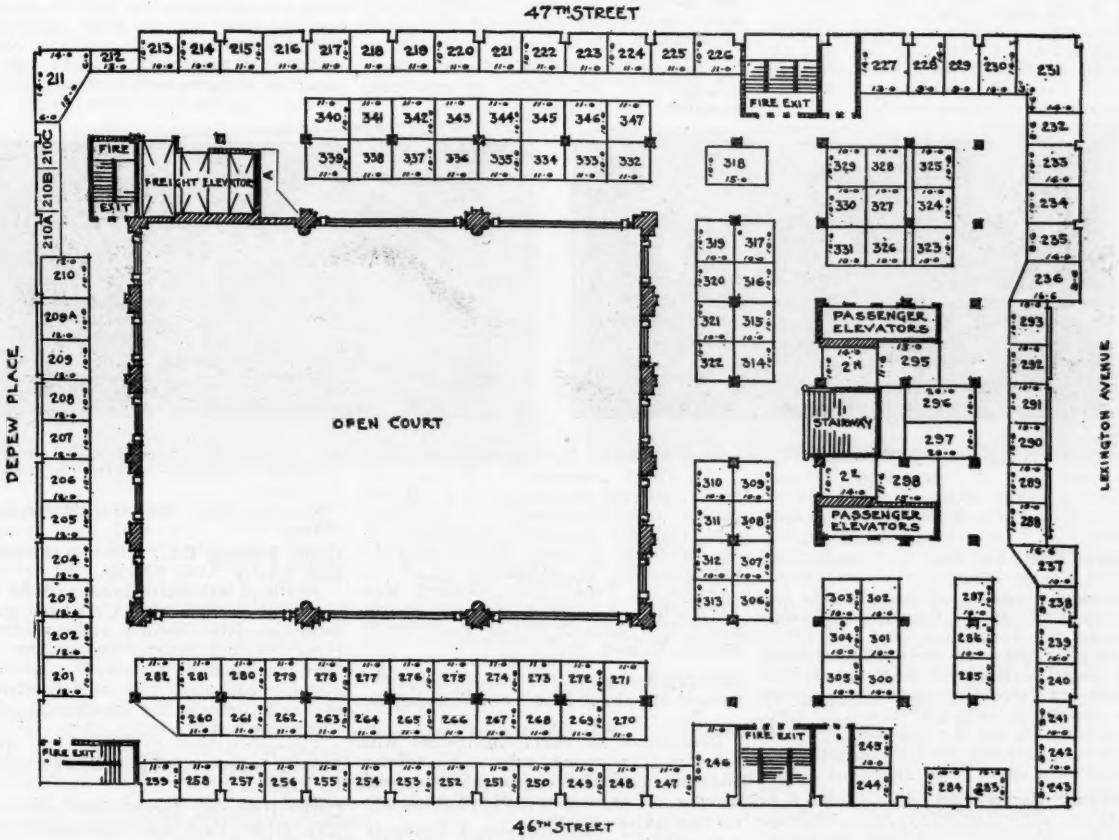
Representatives: Everett M. Stevens, vice-president and general manager; W. W. Booth, New York representative; L. M. Reed, Connecticut representative; D. J. Stump, Boston representative.

A. M. Byers Co., Booths 232, 233
Pittsburgh, Pa.

Genuine wrought iron pipe as manufactured for the last 65 years by this company will constitute the display, description being given both by motion pictures and by colored still pictures of the company's new process, known as "shotting."

Representatives: L. M. Johnston, vice-president; T. L. Lewis, general manager of sales; M. J. Czarniecki, assistant general manager of sales; G. W. Hamill, New York district sales manager; Fletcher Collins, special representative, R. L. Law, H. L. Chute, Lee Turner, New York.

Carboloy Co., Inc., Booths 336-39
350 Madison Ave., New York, N. Y.



PLAN OF MEZZANINE FLOOR BOOTHS 201 TO 347

Brown Instrument Co., Booth 49
Philadelphia, Pa.

Pyrometers, flow meters, CO_2 meters, tachometers, thermometers, pressure gages, automatic controls and resistance thermometers of flush type mounted on large steel panels will be shown here. As a special feature will be a large 4-ft. working model of the flow meter, also new apparatus will be shown consisting of distant-reading instruments which work on the inductance bridge principle.

Representatives: R. P. Brown, president; C. H. Kerr, vice-president and general manager; G. W. Keller, vice-president and general sales manager; J. P. Goheen, secretary; M. M. Watkins, New York manager.

Bryan Boiler Co. Booths 537, 538

Edwin Burhorn Co., Booth A
Foot of West 5th St., Bayonne, N. J.

Burhorn water cooling systems will be exhibited here, a special feature being a working model of a 1929 system of automatic water distribution. Improvements emphasized in the exhibit will be the water distribution in the Smaltower and standard types of tower, also more efficient disposition of cooling surface with the louver system to provide greater air exposure to the water and give more effective cooling with no greater first cost. An improvement displayed will be a trough distributer with spray nozzles arranged to discharge the water uniformly over the entire area of the tower.

Representatives: Henry A. Stover, Jr., in charge; Charles A. Heisterkamp.

Carborundum Co., Booth 22
Perth Amboy, N. J.

Products shown here will include Silicon carbide, fused alumina refractory products sold under the name of Carbofrax and Aloxite and high temperature insulating brick known as Infrax. Panels will be displayed representing furnace wall sections, each panel showing how these products are used in a particular type of furnace wall, covering air-cooled, water-cooled and solid walls. A new type of suspended arch with a refractory veneer will also be displayed.

Representatives: C. E. Hawke, general sales manager; S. A. Fenno, Cleveland district manager; J. A. King, H. J. Ransley, F. W. Miller, J. G. Fritzinger, salesmen, refractory division.

Carrier Engineering Corp., Booth 14A
850 Frelinghuysen Ave., Newark, N. J.

A. W. Cash Co., Booth 274
3rd and Eldorado Sts., Decatur, Ill.

Celite Products Co., Booth 14
11 Broadway, New York, N. Y.

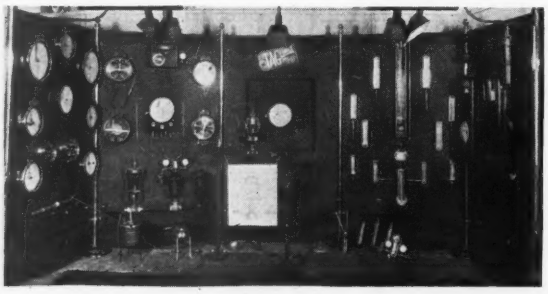
Century Electric Co., Booths 626, 627
1806 Pine St., St. Louis, Mo.

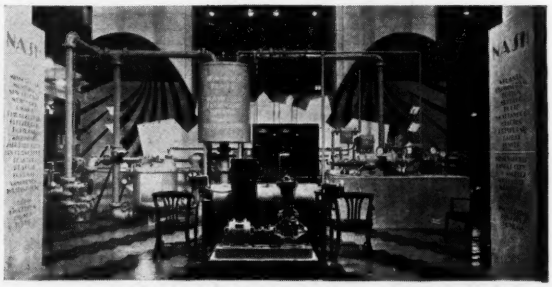
Products to be shown in this booth will be motors and fans, the main features of the exhibit being large squirrel cage motors and multi-speed motors. Some equipment of Roth Brothers & Co. which is now a division of the Century Electric Co. will also be shown.

Representative: James Larkin, New York district manager.

Clements Mfg. Co., Booth 563
601 Fulton St., Chicago, Ill.

Clements Cadillac portable electric blowers for both hot and cold air, also various attachments for both blowing and suction use will be exhibited and recent improvements demonstrated.





Representatives: W. J. Clements, vice-president; C. A. Bremmer, manager blower division; Wm. H. Cline, W. C. Irwin, New York; R. M. Sitterley, export manager.

Clipper Belt Lacer Co., Booth 265
Grand Rapids, Mich.

Various models of belt lacers, belt fasteners or hooks, belt cutters with safety feature and connecting pins will be on display covering the entire Clipper line. As special features will be found an electrically operated Clipper ship and among the new products displayed will be speed lacers Nos. 6 and 8 which will lace both ends of a 6 or 8-in. belt in 1½ min.

Representative: John Jepson.

Cochrane Corporation, Booth 67
17th St., near Allegheny Ave., Philadelphia, Pa.

Apparatus to be exhibited by this company will include a deaerator especially designed to protect the piping of hot water service and heating systems from oxygen corrosion and arranged to be installed in one corner of the basement close to the ceiling, with thermostatic controls to maintain the desired water temperature; a steam purifier for protecting superheaters, turbines, and other prime movers from water and solids carried over from the steam boilers; a discharger with apparatus for demonstrating the mechanism and designed for handling large quantities of water under high pressure; a one-piece tandem steel boiler blow-off valve; multiport back pressure or atmospheric relief valve with new design of muffle chamber to prevent hammering of the valve disc upon the seat; a drainer or large capacity steam trap for pressures up to 75 lb. per sq. in.; recorder for measuring the flow over a V-notch or other form of weir which records and indicates the flow; feeder for supplying acid solution in proportion to the flow of water or other liquid, air under pressure being controlled by the valves and other parts and transmitted to the surface of the acid solution, which is thus prevented from coming in contact with the mechanism. In the discharger, for handling large volumes of water under high pressure, the level of the water acts upon displacement weights, which actuate a pilot valve, so that the main discharge valve may have any desired aperture and large discharge capacity is made possible. In the multiport valve, individual discs are fitted with a vapor cushion chamber instead of a liquid dash pot so that they are unaffected by freezing. The acid feeder probably has many applications for various industrial processes and is worth investigating where any difficult problem is likely to be encountered.

Representatives: J. C. Jones, general manager; H. E. Sibson, general sales manager; A. B. Wallem, general works manager; V. A. Rohlin, chief engineer; J. D. Yoder, manager; C. E. Joos, engineer, softener department; J. E. Harris, general sales department; O. H. Woolford, manager of meter department; F. M. Patterson, manager of discharger department; W. W. Montalvo, Jr., F. B. Sage, A. R. Foote, Chas. Willard, New York office; E. Greene, manager Boston office; H. J. Meier, Chicago; Frederick H. Mason, Detroit.

Connery & Co., Booth 3
Second St., above Erie Ave., Philadelphia, Pa.

Breechings, air ducts constructed with Connery's improved expansion stiffener and the Connery improved air cooled damper and expansion stiffened stack connection will be shown.

Representatives: W. M. Connery, president; E. C. Aucott, secretary; A. D. Stewart, C. B. Nicholson, W. J. Henderson.

W. B. Connor Co., Inc. Booth 467
Lincoln Park, N. J.

Connor non-return steam traps and direct return pumping traps will be shown, the features of these traps and their method of operation being demonstrated.

Representatives: Arthur E. Nealy, manager steam and water specialty department.

Consolidated Ashcroft Hancock Co., Inc.,
Elias St., Bridgeport, Conn. Booth 60

Display of the American Schaeffer & Budenberg Corp. will be made in this booth showing recording and indicating thermometers, recording and indicating gages, pop safety and water relief valves, Hancock bronze cast steel and forged steel valves, and as a special feature the new power control valve.

Representative: W. P. Bradbury, general sales manager, in charge.

Consolidated Gas Co., Booth 7
New York, N. Y.

Consolidation Coal Co., Booths 526, 527
15 Broad St., New York, N. Y.

Cooper-Hewitt Electric Co., Booth 4
410 Eighth St., Hoboken, N. J.

Mercury switches, Neonglow lamps, sign flashers, pressure controls.

Representatives: Charles F. Strebig, D. R. Grandy, L. F. Gerisch, H. M. Ferree, G. H. Engel.

Crane Co., Booth 52
836 So. Michigan Ave., Chicago, Ill.

The Crane exhibit will include new design steel valves for 1500 lb. working pressure, 750 deg. F., total temperature and also standard brass products. Special features of the exhibit will be new designs for extreme high pressure and temperature service and three valves with new operating mechanisms by means of hydraulic cylinders, electric motors and air motors.

Representative: Malcolm Baxter, Jr., in charge.

Crane Packing Co., Booths 650, 651
1800 Cuyler Ave., Chicago, Ill.

Products exhibited here will be new and will include the Universal gasket strip, specially treated endless metallic rings for condensers, evaporators, and heat exchangers, a full line of semi-metallic packings, also models showing the new process for condensers which eliminates ferrules.

Representatives: Thomas G. Munro, Roy A. Schroeer, Newell Brackett, Frank E. Payne.

Cutler-Hammer, Inc., Booths 261, 262
12th & St. Paul Sts., Milwaukee, Wisc.

Dampney Company of America, Booth 62
Hyde Park, Boston, Mass.

This company will exhibit its complete line of Apexior protector coatings for metal surfaces and will show equipment that has been developed for applying it expeditiously to the internal surfaces of boiler, economizer and condenser tubes. Available for inspection will also be a number of samples of boiler tubes that have been pickled for the removal of scale and later treated with Apexior, to show the durability of the coating after various lengths of service under operating conditions.

Representative: C. F. Moore, vice-president, in charge.

Dardelet Thread Lock Corp., Booth 415
120 Broadway, New York, N. Y.

Dearborn Chemical Co., Booth 13
310 So. Michigan Ave., Chicago, Ill.

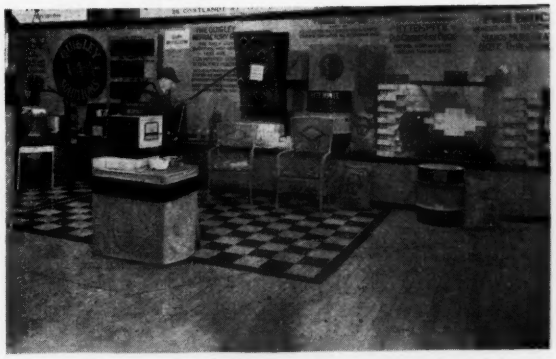
Samples of boiler feedwater treatment,

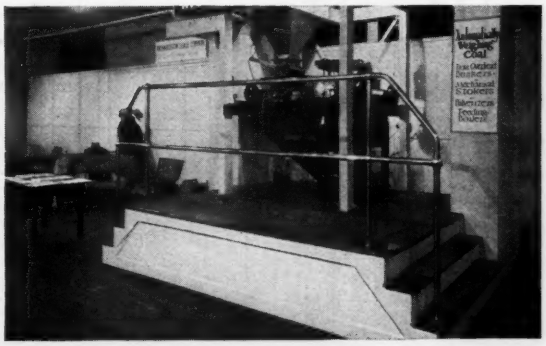
No-Ox-Id rust preventive, lubricating oils and greases, also Dearborn cleaners and as a special feature a new product developed during the past year called No-Ox-Id-Idized asbestos felt wrapper will be shown.

Representatives: Edward C. Brown, vice-president and eastern manager; W. H. Kinney, sales manager, eastern railroad department; C. A. Remsen, eastern manager, department of specialties; Messrs. Platt, Harris, Carr, Tibbetts and Opdyke.

DeBothezat Impeller Co., Inc., Booths 423, 424
1932 Park Ave., New York, N. Y.

Fans, their performance and uses for heating and ventilation will be the subject of this display. Included in the exhibit will be a 48-in. pressure fan for silent operation, 36-in. fan for industrial applications, 24-in. fan for location inside a duct with motor outside the duct, 30- and 24-in. free delivery fans, 8-in. forced draft fan for one inch static pressure,





window ventilator and table fans, high-pressure disc fans and demonstration apparatus, impeller and disc type blowers, demonstration of flow phenomena around fan blades, unit heater with automatic humidifier, air filtering unit, Cyclonic exhaust ejector. High-pressure, and high efficiency with disc fans having non-overload power characteristics will be specially featured.

Representatives: A. G. Nichols, manager; R. F. Ruggles, sales manager.

Dennis Engineering Co., Booth 251
243 No. High St., Columbus, Ohio.

Dennis expansion joints for turbine-condenser connection, L-R first pass soot and slag blowers, models of each class of equipment, and photographs of late installations and modifications will be shown in this space.

Representatives: B. W. Dennis, president; L. R. Lickert, Harold Harvey.

Julian d'Este Co., Booth 250
Cambridge & Spice Sts., Boston, Mass.

Curtis engineering specialties will be exhibited here, including a complete line of pressure reducing valves, damper regulators, also return and non-return steam traps, of bucket and float types. Special features will be a new type T return trap and the Curtis packless excess pump regulator. The type T trap is operated by means of a pilot valve which in turn is controlled by the rising of the float in the body of the trap. The various new features of design will be fully demonstrated. In the packless pump regulator, packings and joints have been eliminated, control being by means of a single diaphragm.

Representatives: D. A. Herrick, in charge; W. T. Hill, Joseph Meyer, W. A. Viets, George Bezanson, Deane Moores.

Detroit Stoker Co., Booths 203-6
General Motors Bldg., Detroit, Mich.

Detroit multiple retort underfeed stoker, with parts of the housing cut away to show the gears and roller bearing mountings will be displayed and the level fuel bed action demonstrated. Also, control of the amount of coal entering the furnace in each retort by means of adjustment on the stoker connecting rod for that retort which can be made while the stoker is operating. A triple retort underfeed stoker will be shown for the first time, of side cleaning type and with other features and adjustments the same as for the rear cleaning stoker; refuse is removed from dump plate at the side into ash pit. This stoker will be operated by a ¼-hp. motor to illustrate the small amount of power required. A Detroit Junior stoker will be shown for the first time, intended to serve boilers from 30 to 100 hp., of ram type and having the same features of fuel control and distribution as the large stokers. This will be shown in operation at the show. Photographs and signs will ornament the walls of the booth showing representative users of Detroit stokers and views of the plant.

Representative: Thatcher W. Rea, sales department.

Diamond Chain & Mfg. Co., Booth 320
Indianapolis, Ind.

Diamond Expansion Bolt Co. Booth 480
Garwood, N. J.

Diamond Power Specialty Corp.,
Detroit, Mich. Booths 16, 17

Soot blowers, including a specially designed blower head for use with air, and moving pictures showing the application of soot blowers and the savings effected thereby, will constitute the exhibit in this space.

Representatives: N. L. Snow, president; W. P. Thomas, vice-president; G. L. Davis, assistant sales manager; L. W. Nones; R. L. Townsend, W. J. Fitzburgh, H. D. Folinsbee.

Joseph Dixon Crucible Co., Booth 257
Jersey City, N. J.

Graphite products, including flake lubricating graphite, graphite greases, belt dressing, graphite seal, graphite pipe joint compound and miscellaneous graphite products will constitute this display.

Representatives: E. S. Glauch, in charge; E. G. Fram.

Dodge Manufacturing Corp., Booth 32
Mishawaka, Ind.

Dodge-Timken bearings for power plant service will be featured as well as their application to various types of machinery for power plants, material handling and power transmission.

Representatives: W. W. French, advertising manager; F. T. O'Hara, manager dealer sales; C. W. Brett, New York manager; Franklin Morse, special eastern sales representative; D. M. Johnson, eastern engineer; J. T. Coghill, Dodge-Timken division; R. L. Hinch, R. T. Pearce, material handling division.

Doehler Die Casting Co., Booth 409
272 Lafayette St., New York, N. Y.

Die cast stock gears and Bond standard stock gears will be exhibited here, a specail feature being a moving exhibit of the Doehler gears showing different motions to be obtained by the use of various types and the conversion of radial to rectilinear motion by the use of spur and internal gears. A new addition to the stock line is 12-pitch die cast gears.

Representatives: H. D. Stanley, manager of gear division, in charge; F. A. Corrente, W. G. Stanley.

Dri-Steam Valve Sales Corp., Booth 3F
565 Fifth Ave., New York, N. Y.

C. A. Dunham Co., Booths 235, 236
450 E. Ohio St., Chicago, Ill.

Durametallic Corp., Booth 408
806 Cobb Ave., Kalamazoo, Mich.

On display will be a new and efficient type of flexible semi-metallic packing called Durametallic B-10, C-10 and D-10. The letters designate the type of metallic wrapper, the packing being made by wrapping various Durametallic metals about a central elastic core. In addition to the new Core Durametallic, will be displayed regular types in spirals and in sets of die-molded split rings, also Dura Plastic, a semi-metallic packing, will be on display.

Representatives: C. C. Hall, vice president; Wilbur N. SarVant, New York; J. J. McQuillen, Herbert Lewis, Pittsburgh, Pa.

Duriron Co., Inc. Booth 6
Dayton, Ohio.

Duriron equipment will here be shown including an exhaust fan, self-priming acid pump, valves, fittings and ejectors. Also there will be a variety of castings and rolled products of Durimet, a new acid-resisting steel and castings of chrome nickel steels. Special features will be the self-priming acid pump and the parts made from the new alloy products. Durimet is a new development, a chrome-

nickel-silicon steel which can be welded, riveted and fabricated to any desired form while having high resistance to weak acid solutions.

Representatives: M. W. Smith in charge; W. E. Pratt, J. L. Kough, W. K. Sims, J. A. Boyd, S. P. Brown, W. H. Scott, E. H. Platz, P. D. Schenck, H. R. Daniels.

Ediplate Corp., Booth 410
Orange, N. J.

At this year's show this company will exhibit floats, made by an exclusive process developed at the Edison laboratories, for pressures up to 1,000 lb. per square inch and as a new feature just developed will be shown a one-piece nickel float with detailed improvements.

Representatives: Wirt R. Rossnieord, vice president; K. G. W. Leaf.

Edward Valve & Manufacturing Co
East Chicago, Ind. Booth 506

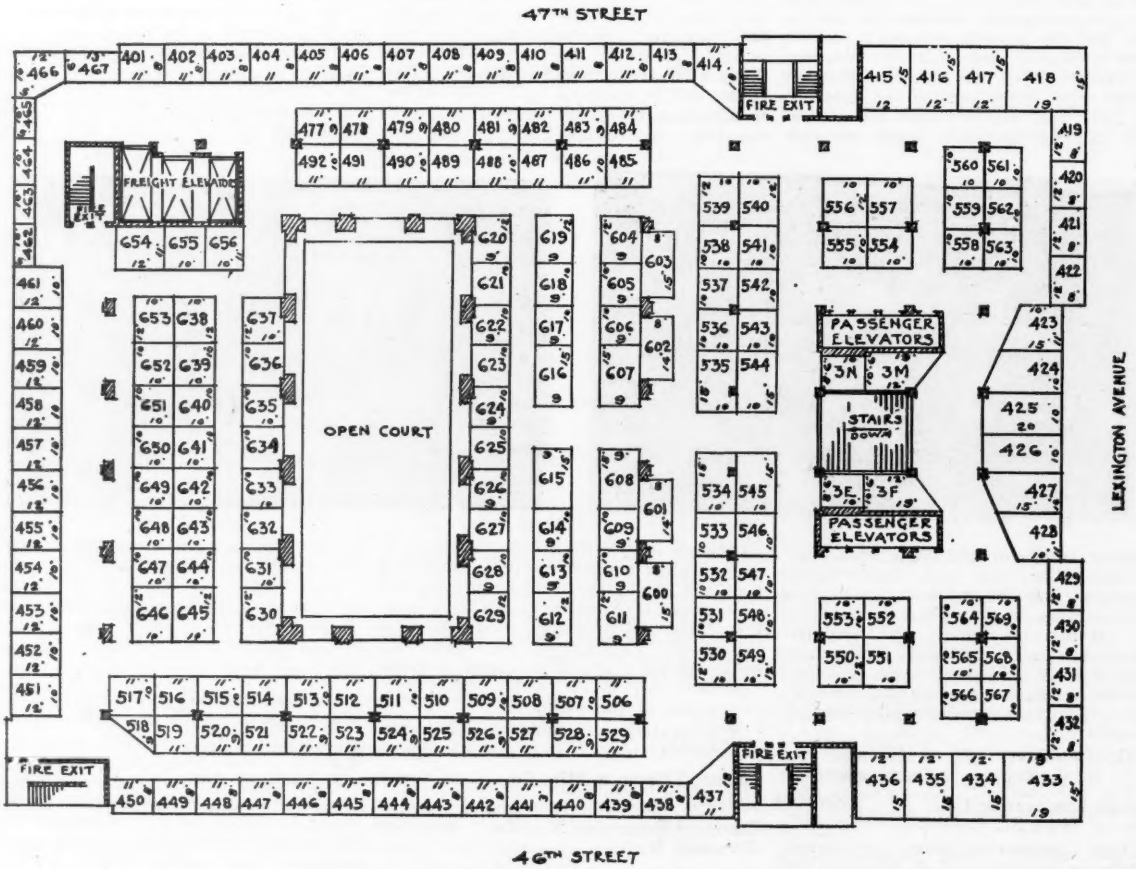
Products to be shown here will include a 10 in. 1350 lb. W. S. P. cast steel globe non-return valve, with Limitorque motor control, intended for the new South Amboy station of the Jersey Central Power & Light Co. Also will be shown a 2½ in. model angle non-return valve with double combination radial and end thrust ball bearings, impactor wheel and the modified Edward type of internal working parts; this will be sectionalized to show the features of construction. Another feature will be a forged steel globe stop valve for 400 to 600 lb. and also for 900 to 1350 lb. safe working pressure.

Representatives: W. W. Crawford, president; W. W. Mohr, chief engineer; J. R. Goodwin, New York representative.

Electric Storage Battery Co. Booth 428
25 W. 43rd St., New York, N. Y.

Ellison Draft Gage Co., Booth 44-B
214 West Kinzie St., Chicago, Ill.

Pointer type air filter gages, cover type U draft gages for oil and mercury operation, dial type gages in 1, 2 and 3 pointers and straight-line movement type gages with scale showing gas flow through the boiler will be features of this exhibit. The gages will be shown in detail and their applications demonstrated.



PLAN OF THIRD FLOOR BOOTHS 401 TO 656

Representatives: Lewis M. Ellison, Walter T. Ritter, Charles C. Phelps.

Charles Engelhard, Inc. Booth 74
Chestnut St. and N. J. R. R. Ave., Newark, N. J.

Pyrometers, electric resistance thermometers, portable meters, CO_2 and stack temperature recorders will make up the display in this booth. Also a small furnace will be in operation showing the action of the pyrometers and a special thermo couple to give average temperature reading with the resistance thermometer placed in the furnace to check the pyrometer.

Representatives: W. O. Hebler, G. A. Hunkele, H. M. Carter, J. Y. Smith, A. C. Schmid.

Engineer Co., Booth 18
17 Battery Place, New York, N. Y.

Products shown here will be the Enco baffle walls, combustion control and oil burning equipment. For the first time will be shown a large combination gas and oil burner for developing as high as 2500 hp. per unit.

Representative: A. W. Patterson, vice president.

Equipment & Supply Co., Inc.
51 Madison Ave., New York, N. Y.
Booths 401, 402

This company will exhibit a counterbalanced drafting table which can be operated from two pedals, to give any height or angle. The special features will be metal base with weights counterbalancing the board so that adjustment is automatic.

Representatives: James H. Hine, William Geiger, James H. Stickler, Daniel Werth, J. F. Noll, S. Duane Lyon.

Erie City Iron Works, Booth 91
Erie, Pa.

Equipment to be featured here will be the Erie City products including two-drum waste-heat boiler, Unitype pulverizer, three-drum boiler fired by various methods; cross-drum boiler, Vortex applied to h.r.t. boiler, steel heating boiler, all shown by means of a displayor which will describe the products and show various installation features.

Representative: C. W. McHose, New York, in charge.

Everlasting Valve Co., Booth 41
1 Exchange Place, Jersey City, N. J.

Valves of all descriptions will make up this display, the main features including Everlasting valves, Companion angle

valves, special water column valves and duplex blow-off unit. Of interest will be the Everlasting special valve for 500 lb. pressure and the Companion angle valve for light pressure.

Representatives: John H. Allen, president; Wylie G. Wilson, consulting engineer; E. N. Corning, sales engineer; George M. Elton, Jr., Edward Boll, S. I. Anderson, home office sales staff.

Fairbanks Co., Booth 259
393 Lafayette St., New York, N. Y.

Falk Corporation, Booths 540, 541
Milwaukee, Wisc.

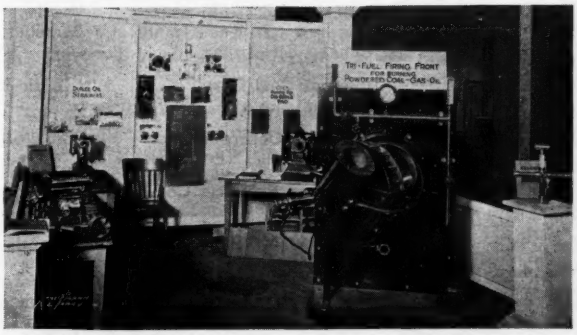
Herringbone gears, speed reducers and flexible couplings will make up the display in this booth.

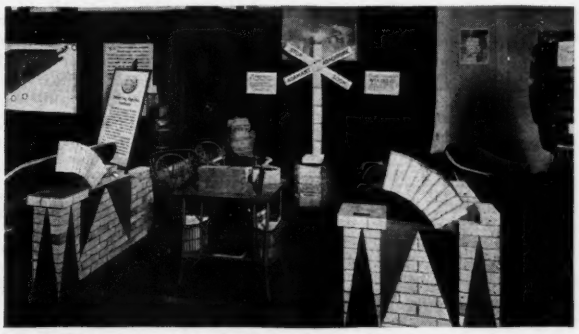
Representatives: Mason Hulett, F. A. Stahl, E. A. LeMay, New York; W. L. Schneider, P. C. Day, chief engineer, Milwaukee.

Fire King Stoker Co., Booth 8
Indianapolis, Ind.

Fisher Governor Co., Booth 610
Marshalltown, Iowa.

The company's regular line of Fisher





automatic steam and power plant specialties will be on exhibition, including pump governors, reducing valves, steam traps, back pressure valves, float valves, liquid level controllers, strainers and other automatic pressure devices. A new feature to be displayed will be the master control unit, a multi sensitive valve, pilot controlled and easily adjusted.

Representatives: L. W. Browne, treasurer and general manager; J. F. Hollwell, sales engineer.

Fitzgibbons Boiler Co. Booths 254, 255
570 7th Ave., New York, N. Y.

Several sizes of Fitzgibbons boilers will be shown, replicas of the large size power and heating boilers.

Representatives: G. E. Olsen, manager of sales; Raymond Newcomb, associate manager of sales.

Foster Engineering Co., Booth 84
109 Monroe St., Newark, N. J.

Various types of pressure regulators, pump governors, boiler shop valves and the like will be shown of standard design and also of steel for high pressures and temperatures. Many parts will be sectioned to show details of construction. Foster Sight Flow box will be a special feature.

Representatives: Charles A. Olson, president; James T. Hayden, treasurer; George E. Breece, general sales manager, in charge; William E. Heck, assistant sales manager; William E. Ward, Henry J. Fortier, New York; Harry T. Wentworth, chief draftsman; James D. Rostron, Pennsylvania representative; Elmer W. Johnson, Chicago manager; William R. Ladewig, Los Angeles.

Foundation Co., Booths 296, 297
120 Liberty St., New York, N. Y.

Foxboro Co., Booths 403, 404
Foxboro, Mass.

O. E. Frank Heater & Engr. Co. Booth 10
20 Millburn St., Buffalo, N. Y.

A three-unit full-size, Frank heat reclaimer will be displayed, so mounted that its application and details of construction can be clearly seen, with all piping and arrangement as in an actual installation. The purpose is to salvage heat ordinarily lost to the sewer, in soiled waste liquids such as are discharged from laundries and chemical manufacturing plants, and return this heat into clean fluids for process work.

Representatives: Olive E. Frank, president; H. P. Wilder.

Fuller Lehigh Co., Booth 54
Fullerton, Pa.

For the first time this company, a Babcock & Wilcox organization, will exhibit the grinding elements of its new Fuller Lehigh Type B table mill. Also will be shown an actual bottom corner section of a Bailey water-cooled, slag-tap furnace with construction of this type furnace including the tube, block, tie-row, and air-cooled floor details, and the method used to seal the furnace against air infiltration. Samples of slag from a furnace of this type will be displayed. To show drawings and photographs of some 50 Fuller Lehigh installations of pulverized coal equipment and water-cooled water walls, a special displayor will be used giving pertinent facts regarding each of these installations.

Representatives: E. G. Bailey, president; E. J. Billings, vice president; H. B. Jones, manager, New York office; R. A. Hawk, in charge.

Fulton-Sylphon Co., Booths 219, 220
Knoxville, Tenn.

Fyre-Freez Corp., Booths 244, 245
17 W. 46th St., New York, N. Y.

Garlock Packing Co., Booths 545, 546
Palmyra, N. Y.

A complete line of asbestos, fibrous, metal and special mechanical packings and gaskets will be shown here, the new developments on display being Garlock Chevron packing of wedge expansion principle for rams and plungers of accumulators, pumps and other heavy duty hydraulic equipment.

Representatives: Phil Arnold, vice president; P. D. Miller, New York district manager; F. L. Wallace, Boston district manager; H. W. Gulager, Philadelphia district manager; R. J. Hinkle, advertising manager; C. R. McAfee, J. M. Drinkwater, Joseph Yamin, J. H. Reyelt, J. J. McLaughlin, C. D. Castle, Isaac McAllister, F. P. Morton, H. P. D'Aury, New York representatives.

General Electric Co., Booths 4, 5
Schenectady, N. Y.

General Insulating & Mfg. Co. Booth 414
Alexandria, Ind.

Rock Wool products, including flexfelt, pipe covering, cold storage insulation, sound absorbing material and granulated and loose Rock Wool will make up the complete line to be exhibited in this space.

Representative: G. S. Jones, sales manager.

General Stoker Corp., Booth 27
270 Lafayette St., New York, N. Y.

Model F underfeed stoker with dump grates, eight positive speeds and in capacity to 1250 lb. per hr. will be on display.

Representative: M. W. Crew, president.

Girtanner Engineering Corp., Booth 212
122 Greenwich St., New York, N. Y.

Here will be found a display of ash conveyors, steam, vacuum, hydraulic and pneumatic types; ash storage tanks, in tile, steel and concrete construction, ash pit and furnace doors and soot conveyors. A special feature will be made of soot conveying apparatus for cleaning soot from baffle walls, preheaters, economizers and other boiler parts.

Representatives: Alex Girtanner, president; J. J. McNulta, chief engineer.

Globe Automatic Sprinkler Co.
2035 Washington Ave., Philadelphia, Pa.
Booths 244, 245

James T. Gordon Co., Booths 92, 93
11 Park Place, New York, N. Y.

Products of the Audale Co., simplex, duplex and Rotrex strainers for water and oil, also oil coolers and heat exchangers will be shown. Cleveland Worm and Gear Co.'s worm gear reduction units will be displayed. W. H. Nicholson & Co. products including piston and weight-operated stream traps, all metal flexible couplings, also four-way valves and steam specialties will be exhibited.

Representatives: James T. Gordon, C. W. Dietrich, Jr., Edwain S. Leibman.

Green Fuel Economizer Co., Booth 73
Beacon, N. Y.

Grinnell Co., Inc., Booths 308-11
Providence, R. I.

Featured in this booth will be Ther-

moliers, the company's recently developed unit heater; Grinnell adjustable pipe hangers, power piping hangers and triple XXX line of piping for super-power work. Special demonstration of the unit heater will be featured.

Representatives: J. D. Pryor, vice president; A. W. Moulder, sales manager, heating and power piping; H. E. Branch, publicity and sales promotion; E. J. Morris, New York sales engineer; L. C. Higgins, Philadelphia sales engineer.

Gun-fil Corp., Booth 429
112 S. 16th St. Philadelphia, Pa.

Hahn Engineering Co., Booths 648, 649
Lancaster, Pa.

Steam-jet ash conveyors, cast iron sectional ash tanks and coal bunkers and lined cast iron sectional ash hoppers will be included in this display. Special features emphasized will be a complete elbow set showing the jet-elbow, rebound-fitting and corundum-inserted liners; also a model of an octagonal cast iron tank and one of a side-discharge lined ash hopper. Catalogs will be available covering conveyors, tanks, bunkers and hoppers.

Representatives: W. W. Posey, president; Eugene Hahn, manager; Howard Butt, A. R. Campbell, G. E. Kille.

Hall Laboratories, Booth 21
Pittsburgh, Pa.

Samples of boiler metal which have failed in service through cracking will be shown, samples of steel will be tested to destruction by application of cyclic stress under conditions favorable to corrosion known as "corrosion fatigue and information as to caustic embrittlement" will be given. Demonstration will be made of the relation of these phenomena to boiler design and operation, to prevention of scale and surface corrosion and to making wet steam.

Representative: G. W. Smith, general manager.

Harbison-Walker Refractories Co.,
Farmers Bank Bldg., Pittsburgh, Pa.
Booth 58

Various types of products that the company manufactures including periodic and tunnel kiln fired brick will be shown. At the rear of the booth will be a large size map of the United States in color showing the distribution of raw material deposits, works and sales offices of the company and in the center of the booth a rotating table showing specimens of various refractories. Above the table will be an illuminated sign showing the company's trade-mark. Emphasis will be placed on the improvements which have been effected in the products as a result of the modernization of plants.

Representatives: J. R. Robinson, district manager; S. P. Howze, E. S. Stockslager, New York; J. Spotts McDowell, director of research; E. B. Guenther, Pittsburgh.

Hardinge Co., Inc., Booth 30
York, Pa.

A model of the Hardinge Coal Pulverizer will be shown, also a working model of a Constant Weight feeder. New features of the Coal Pulverizer will be shown for the first time and the feeder is a new product, first exhibited in this show. It regulates coarse and fine feeds to the pulverizer by weight instead of volume, keeping the weight constant.

Representatives: W. H. Withington in charge, assisted by Messrs. Metz, Towers, Sancton, Russell, Dolan, Fleming, Ankeny, Russell and Mason.

Hartzell Propeller Co., Booth 624
Piqua, Ohio.

Hoffman Specialty Co., Inc.,
Waterbury, Conn. Booths 437, 438

Products here shown will include the company's venting valves and controlled heat specialties, Thermador and electric heaters, vacuum and condensation pump and Moto-Heater. Main features of the exhibit will be the various designs of electric heaters and actual operation of a vacuum and condensing pump. As a new feature the Thermador will be shown made up in the form of a small table which heats from the floor up and keeps the air in motion. It may also be used in summer for cooling purposes. The vacuum pump is also a new product and will be shown in operation with glass windows at various points to demonstrate the operating mechanism functions. The pump has steam jet to create the vacuum and eliminate moving parts. The Moto-Heater for garages and industrial buildings, also venting valves and heat specialties will be demonstrated in detail.

Representatives: C. V. Haynes, vice-president and sales manager; W. K. Simpson, secretary; C. W. Stewart, assistant general sales manager; J. K. Peacock, New York; P. D. Rech, general sales department, in charge.

E. F. Houghton & Co., Booths 532-4
240 W. Somerset St., No. Philadelphia, Pa.

Houghton power transmission, lubrication service and the Houghton Pullmeter will be featured.

Representatives: Wayne Daves, manager leather sales department; K. A. Newman, manager lubrication sales department; R. F. Smith, New York manager; J. Coleman Bentley, manager exposition department.

Howell Electric Motors Co., Booth 615
Howell, Mich.

This company will show one of its Brush-Less single-phase motors operating a hoist to demonstrate its reversing characteristics. A similar motor will be shown for display only as well as a totally enclosed self-ventilated model and a standard squirrel cage general duty motor. A new feature will be the capacitor motor for direct connected fan and blower duty with control on the blower.

Representative: Fred K. Stone, eastern district manager.

Paul B. Huyette Co., Booths 81, 82
5 S. 18th St., Philadelphia, Pa.

Products here exhibited will include PBH water gages and gage cocks, protectors, Tiltview water gages, boiler panels, also Hays CO_2 and draft recorders, Cochrane flow meters, Libbey gage glasses and Reliance safety water columns.

Representatives: P. B. Huyette, president; Walter C. Edge, vice-president; P. Wood, secretary; Andrew Bittner, New York manager, in charge of booth; W. Molokie, H. R. Blessing, J. R. Larkin.

Ilg Electric Ventilating Co.,
2850 N. Crawford Ave., Chicago, Ill.
Booths 277, 278

This display will include a 50-in. type B Ilg Universal multiblade blower with direct connected motor and variable air controller; a 30-in. marine type ventilating set with watertight motor; a 24-in. unit heater and a 20-in. power roof ventilator. New features to be demonstrated will be found in connection with the 50-in. blower which has several unusual features of design. Operation of the variable air controller will be demonstrated in connection with a watt meter showing power saved when air volume is reduced, also the unit heater with fan direct connected to single-phase motor with two speed adjustment will be demonstrated in operation.

Representatives: P. D. Briggs, J. O. Lennon, W. G. Thomas, C. W. Stewart, W. G. Burbo, C. A. Suling, H. E. Maynard.

Illinois Engineering Co., Booths 82, 83
Racine Ave. and 21st St., Chicago, Ill.

A glass model of the Fig. 35 steam trap operating under actual working conditions will be shown, also a display of high pressure and low pressure steam specialties and a small size zone control valve. Especially featured will be the operating model of the steam trap.

Representatives: James C. Matchett, John L. Ehretsman.

Imperial Coal Corp., Booth 36
342 Madison Ave., New York, N. Y.

Industrial Controller Co., Booth 613
30 Church St., New York, N. Y.

Insulating Products Corp., Booths 25, 25A
280 Madison Ave., New York, N. Y.

International Nickel Co., Inc., Booth 9
67 Wall St., New York, N. Y.

Monel metal and pure nickel in commercial forms, including rod, sheet, tubes, strip, wire, forgings, and castings will be exhibited; also samples of finished vital parts of power plant equipment as produced by leading manufacturers in this field.

Representatives: L. Mueller-Thym, in charge; R. E. Mason, A. H. Galley.

Invincible Vacuum Cleaner Mfg. Co.,
Dover, Ohio. Booths 639-52

A complete line of portable vacuum cleaners will be shown including the new industrial model for factories as well as heavy duty portable models for office buildings, hotels and the like. A complete assortment of tools and attachments for cleaning floors, walls, ceilings and other difficult places, will be demonstrated.

Representatives: R. G. Harker, manager of sales; Arthur Rocke, New York manager; J. E. Nestell, special sales engineer; G. S. Githens, New England manager.

Irving Iron Works Co., Booths 439, 440
3rd Creek St. & Dutchkills Creek, Long Island City, N. Y.

Irvico steel flooring and Safsteps with numerous applications of these products will be displayed. Main features of the exhibit will be an assembled platform with steps leading to it showing in a practical way the advantages of these products. New features and improvements will include the Irvico continuous flooring and Irving continuous armoring for concrete and mastic floors, illustrating the application of the streamline splice.

Representatives: Walter E. Irving, president; Paul Leon Price, treasurer and general manager; J. H. Miller, William Noblett, C. S. Line, sales representatives.

Jenkins Bros., Booth 90
80 White St., New York, N. Y.

Jenkins Bros. general line of Jenkins bronze and iron valves will be displayed in this space. As a special feature there will be a 20-in. motor operated iron body gate valve.

Representatives: W. G. LeCompte, vice president; James R. White, secretary; Alfred Engle, F. C. Ernst, H. J. Barnsley, F. G. Jolley, William H. Utz.

Johns-Manville Corp., Booth 14
292 Madison Ave., New York, N. Y.

Industrial insulations, packings and building materials will make up the display in this booth. A main feature will be a panel showing complete insulation service for all temperatures ranging from 2500 deg. F. to refrigeration temperatures. A new development will be that the structural effect will be of J-M Transite.

Representatives: H. A. Kieselbach, F. J. Wakem, H. N. Doscher, M. Craighead, M. K. Cumming, W. W. Bainbridge, F. T. Crow, F. H. Emerson.

W. A. Jones Foundry & Machine Co.,
4401 W. Roosevelt Rd., Chicago, Ill.
Booths 300, 301

Here will be shown three types of speed reducers, the worm gear, spur gear and the herringbone. The exhibit will show the application to industrial work and the great range of speed reduction possible. A new feature will be the herringbone machine which has just been put on the market.

Representatives: R. B. Moir; L. Erickson, New York.

Justus Steam Trap Co., Booth 325
Napanoch, N. Y.

Justus steam traps will be demonstrated, showing as a main feature the improved pilot valves and a model of the valve in operation.

Representatives: Messrs. Justus, Tichenor, Norden.

E. F. Keating Pipe Bending Co.,
452 Water St., New York, N. Y.
Booths 229, 230

Reinforced square corner Van Stone Joints made from genuine wrought iron, lap welded steel, seamless steel and Toncan iron pipe; also large bends, welded headers, pipe coils, high-pressure piping, boiler tubes and valves will be displayed.

Representative: M. Readey, secretary.

Keller Mechanical Engineering Corp.,
70 Washington St., Brooklyn, N. Y.
Booths 644-7

M. W. Kellogg Co., Booth 47
225 Broadway, New York, N. Y.

This company will exhibit the latest developments pertaining to power house construction including forge and hammer lap welded boiler drums, headers, receivers and piping. Photographs and enlarged microphotographs will be shown in the booth, also as a special feature, a 30-in. outside diameter high-pressure header for the Puget Sound Power & Light Co., designed by Stone & Webster Engineering Corp. Latest improvements in high pressure and superheat flanges and joints will be included in the display.

Representative: H. S. Newlin, engineer, in charge.

Kelly Co., Booths 273, 274
372 W. Grand Ave., Chicago, Ill.

Products to be shown in this space will include globe, angle and gate valves and as a special feature the neway gate valve with novel features.

Representative: C. Wilson Gill.

Kempton Manufacturing Corp., Booth 629
148 W. 23rd St., New York, N. Y.

Here will be shown E-Z bolt anchors, electrical testing instruments and a demonstration of the anchors and instruments.

Representatives: Arthur K. Kempton, president; L. Lockquell, general sales manager.

Keystone Lubricating Co., Booth 3
21st & Lippincott Sts., Philadelphia, Pa.

Keystone greases, grease cups, safety lubricators, Pneuma-Lectric lubricating system and a demonstration of various hook-ups and methods of applying these systems, will be shown. Automatic lubrication at such intervals as needed is secured by a contact-making clock, operating a motor which supplies pressure on the system. The only attention needed is the occasional filling of the grease tank and keeping the clock and motor in condition.

Representatives: H. A. Buzby, president; A. T. Lowry, New York district manager; L. A. Webster, Boston district manager; G. W. Hall, Pittsburgh district manager; C. O. Norstrum, special representative; H. M. Ludwick, mechanical engineer; L. R. Humpton, electrical engineer; F. D. Street, sales engineer, Philadelphia.

Keystone Refractories Co., Booth 11
120 Liberty St., New York, N. Y.

This company will have on display Dura-Stix firebrick cement, Steel-Veneer and Crundumsand granular refractories, Plastobrix firebrick, also Keystone refractory sprayer for applying refractory materials to furnace linings.

Representatives: Frederick W. Reisman, president and general manager, in charge; L. E. Turk, secretary and treasurer; B. G. Pitcher, F. M. Leach, P. Murphy, J. G. Collier.

Walter Kidde & Co., Inc., Booths 292, 293
140 Cedar St., New York, N. Y.

Kieley & Mueller, Inc., Booths 281, 282
34 W. 13th St., New York, N. Y.

Products to be shown in this display will consist of pressure reducing valves, damper regulators, boiler water feeders and steam traps.

Representatives: J. O'Connor, secretary and treasurer; C. H. Dutcher, manager.

Kilsoot Chemical Co., Inc., Booth 3N
1834 Broadway, New York, N. Y.

King Refractories Co., Booth 95
1715 Niagara St., Buffalo, N. Y.

Kings Co. Lighting Co., Booth 7
Brooklyn, N. Y.

Kissick-Fenno Co., Inc., Booth 19
15 Park Place, New York, N. Y.

This space will contain a Copes feedwater regulator exhibit for high pressure service, also regulators for steam flow, water pressure regulating valves, pump governors and orifice discharge valves with tripper type thermostats.

Representative: J. Kissick, Jr.

"Klingerit" Inc., Booth 317
16 Hudson St., New York, N. Y.

Valves, Reflex boiler water gages, Klingerit original sheet asbestos packing will be displayed here and as special features high pressure Reflex water gages and valves. New development of the high pressure water gages for use with working pressures up to 1800 lb. will be included.

Representative: Herman Strahman, treasurer.

Korfund Co., Inc., Booths 554, 555
235 E. 42nd St., New York, N. Y.

This exhibit in connection with the Troy Engine & Machine Co. will feature the Troy engine in operation and a large number of foundation plates and shock absorbers. The self-oiling features and details of construction of the Troy engine will be fully illustrated.

Representatives: S. Rosenzweig, president; H. B. Villiers, J. Schnitzbauer.

Kraissl Co., Booth 430
17 Madison Ave., New York, N. Y.

Fuel oil pumps for use in connection with oil burning plants, vacuum pumps for direct connection where quiet operation under continuous service is desired, rotary compressors for higher pressures than usual, rotary liquid pumps with modifications and improvements, small capacity centrifugal pumps, turbine pumps for low capacity against high head and a complete line of single and duplex designs of strainers will be found in this display.

Representative: F. Kraissl.

LaBour Co., Booth 31
Elkhart, Ind.

This year the company will display primarily its self-priming centrifugal pumps with a pump in operation equipped with glass parts to make visible the inner workings of the pump and to demonstrate its ability to handle air and prime itself when starting with an empty suction. In addition to the pumps, miscellaneous castings made from the corrosion resisting alloy Elcomet will be displayed and demonstrations made of the resistance to corrosion by parts exposed to acids and chemical solutions.

Representatives: H. E. LaBour, N. A. Pedersen, John H. Barker, C. S. Savage.

LaFavorite Rubber Mfg. Co.,
Hawthorne, N. J. Booth 210-A-B-C

Lancaster Iron Works, Inc., Booth 648
Lancaster, Pa.

Lead Lined Iron Pipe Co., Booth 10
Wakefield, Mass.

Wakefield galvanized amalgamated lead lined pipe, fittings, and the like for hot and cold water service connections, amalgamated acid resisting flanges, fittings and valve for acids and other corrosive liquors, tin lined pipe for use on carbonated and distilled water and fruit juices, hard lead pipe, fittings and pumps, lead and tin covered pipe, fittings, valves and coils and lead lined and lead covered pumps will be found in this display.

Representatives: Thomas E. Dwyer, Dennis F. Dwyer, manager; John D. Dwyer, John J. McGurty.

Leavitt Machine Co., Booth 528
Orange, Mass.

Complete line of Dexter valve reseating machines will be demonstrated and details displayed at this booth. Operation of the machines for various sized valves and also for faucets will be demonstrated.

Representatives: E. S. Hersey, sales engineer; R. L. Roth.

Leeds & Northrup Co., Booth 20
4901 Stenton Ave., Philadelphia, Pa.

Special display of generator field and

stator temperature recorders, metered combustion control apparatus and automatic frequency control apparatus will be made. Other features included will be condenser leakage recorders, testing sets, acidity measuring apparatus, temperature indicators, recording pyrometers and thermometers.

Representatives: L. O. Heath, general division sales manager; B. F. Keene, R. A. Mason, D. E. Moat, S. B. Morehouse, H. L. Scutt.

Leslie Co., Booth 535
Lyndhurst, N. J.

Products to be shown in this display will be pressure regulators, reducing valves, pump pressure, excess pressure and temperature regulators, relief valves and self cleaning strainers. Emphasis will be placed on the construction of all devices with wearing and working parts renewable and made of stainless steel, nickel alloy and high-pressure bronze.

Representatives: S. I. Leslie, president; J. J. Cizek, vice president; F. J. Thrush, J. A. DeLong, J. M. Naab, S. Soderberg, R. Courter, F. D. Riggio.

Lunkenheimer Co., Booth 57
Cincinnati, Ohio.

The main feature of this exhibit will be a 6-in., 1350-lb. cast steel, outside-screw-and-yoke globe valve with by-pass. The handwheel will be mounted on an auxiliary shaft, geared to the valve stem, in order to facilitate operation of the valve. The exhibit will also include the standard line of Lukenheimer valves and other steam specialties.

Representative: William Carson, sales engineer.

McAvoy Products Co., Booth 463
19 W. Jackson Blvd., Chicago, Ill.

Cactizona, in liquid and pulp form will be displayed, a main feature shown will be the difference in water when treated with this material.

Representative: Chas. V. McAvoy.

Manistee Iron Works Co., Booth 48
Manistee, Mich.

This company's exhibit will show multi-stage and single stage centrifugal pumps, four-stage motor-driven boiler feed pump also an eight-stage centrifugal pump, and a 12-in. single stage pump.

Representatives: J. R. Ray, Tom Ray, D. J. Rowland, E. S. Quackenbush, J. A. Conlogue.

Marburg Brothers, Inc., Booths 2E-298
90 West St., New York, N. Y.

Thiel precision die filing and sawing machines will be exhibited and demonstrated.

Representatives: Theodore H. Marburg, president; Louis C. Marburg, secretary and treasurer; O. P. Brett, Richard Krause.

Mason Regulator Co., Booths 223, 224
Dorchester Center, Boston, Mass.

This company will show a complete line of its pressure regulators, pump governors, damper regulators and as a special feature a new double diaphragm auxiliary operated regulator.

Representatives: F. A. Morrison, secretary; F. Kenneth Morrison, N. P. Bates.

Mayflower Oil Burner Corp.,
5002 Hudson Blvd., West New York, N. J. Booths 518, 519

Mercoid Corp., Booths 215, 216
564 W. Adams St., Chicago, Ill.

Mercoid controls, used on automatic heating and refrigeration and for miscellaneous purposes will be shown as a full line. Some new features are the Tipless Tube for mercury sealed-contact switches and the warm air furnace control, a bi-metal construction with double adjustment protected within the case.

Representatives: L. H. Van Ness, president; J. W. Owens, vice-president; I. E. McCabe, chief engineer; H. A. Matthews, sales engineer, of Chicago; N. J. Allaben, vice-president, A. N. Schultz, sales manager; W. K. Stauffer, C. A. Biers, of New York.

Mercon Regulator Co., Booth 31
1362 Monadnock Block, Chicago, Ill.

Merrick Scale Mfg. Co. Booths 237-240
Passaic, N. J.

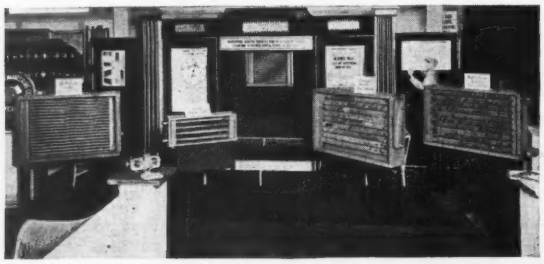
Here will be found the Merrick Conveyor Weightometer, which is also a conveyor scale, the Addoweight weighing buckets for coal passing along a monorail track, the Mechanical Weighman for weighing tanks of material and the Merrick Aequitas, which is a printing scale.

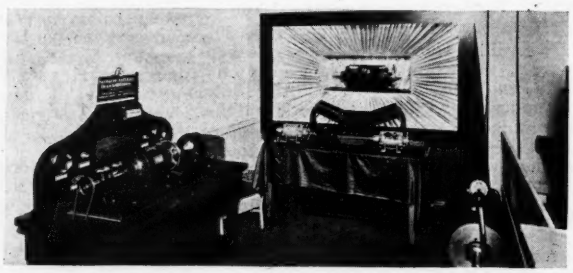
Representative: F. P. Hambright.

Midwest Air Filters, Inc.
Bradford, Pa. Booths 524, 525

Automatic filters will be shown here including horizontal, also sinuous vertical and horizontal types. Standard unit filters, compressor filters and continuous steel inserts, also air humidifiers will be included. Special features will be the filters for continuous or intermittent service and the sinuous vertical filter in small size. New developments are the model U-20 unit air filters with removable filter sections which snap into place, also the sinuous filter in vertical and horizontal types having concave filter plates for throwing out dust and dirt in the air by certrifugal action.

Representatives: John Hellstrom, president; E. Ohnell, Jr., sales manager; E. S. Bishop, New York manager; J. Sprague, New York; G. W. Sonntag, factory representative.





Limitorque Corp., Booth 16
17 E. 45th St., New York, N. Y.

Limitorque control for valves will be illustrated in this exhibit including a motor-operated valve of 10 in. size for 400 lb. pressure, a 6-in. high-pressure steam valve and a complete display of the Limitorque valve control with operating parts exposed. All these devices are new and are exhibited for the first time.

Representatives: Payne Dean, manager; F. M. Read, R. Godfrey.

Linde Air Products Co., Booths 334, 335
30 E. 42nd St., New York, N. Y.

Welding and cutting equipment, a first showing of Oxweld type W-17 low-pressure welding blowpipe; full size oxwelded power plant piping and construction.

Representative: H. H. Griffith, technical publicity department, in charge.

Link-Belt Co., Booths 285-7
910 S. Michigan Ave., Chicago, Ill.

Liquidometer Corp., Booth 630
Skillman Ave. at 37th St., Long Island City, N. Y.

Direct and remote reading tank contents gages, including the company's new Scale gage for measuring by weight liquid stored in large tanks and new line of Aircraft gages will be shown. The Aircraft gages are made in various models for all conditions of mounting, the remote reading type making possible the mounting of the dial on the instrument panel regardless of tank location.

Representatives: R. W. Askins, sales manager; W. E. MacEwen, assistant general sales manager; A. J. White, New York manager; C. A. deGiers, vice president; J. H. Frier, assistant to the president; H. Cullinan, assistant to the vice president.

Millers Falls Co., Booth 431
Millers Falls, Mass.

Electric drills, screwdrivers, hammers, sanders, hole saws and portable grinders will be found here. A new airplane drill and screwdriver for capacity up to 3/16 in. will be featured.

Representatives: George Keller, C. H. Kassebart, J. J. Coleman.

Mine Safety Appliances Co., Booth 268
Braddock Ave. and Thomas Blvd., Pittsburgh, Pa.

Complete line of safety equipment for electric light and power industries including safety lamps, oxygen breathing apparatus, first aid supplies, gas detecting and recording instruments, danger signs, goggles, H-H Inhalators for resuscitation purposes, gas masks, hose masks, and safety clothing will be shown. A new Edison Model F safety lineman's lamp will be shown which consists of a Bakelite head piece and a two-filament bulb operated from a small storage battery carried on the belt. Other features of the exhibit will be the improved gas mask

Midwest Piping & Supply Co., Booth 221
St. Louis, Mo.

face piece and the Jones manhole gas detector, exhibited for the first time.

Representatives: J. M. Lewis, industrial sales manager; H. J. Segrave, New York manager; J. G. Steffen, New York office.

Minneapolis-Honeywell Regulator Co., Booth 246
Minneapolis, Minn.

Industrial motor valves in motor-operated globe and butterfly types for the control of gas or liquid mediums with a dual control unit comprising motor and valve inter-linked for fuel-air regulation will be shown. Also the electric motor-driven speed reducers, for operating semi-balanced and balanced regulating valves and electric motor automatic shut-off valves of direct and reverse-acting types, the opening being accomplished by electric energy and the downward movement by means of springs compressed during the lifting cycle. Other features will be motor-driven steam radiator valve, small magnet operated valves, temperature regulators, pressure controllers applicable to pressures from 20 in. vacuum to 150 lb. gage, safety combustion controllers of both radiant energy diaphragm type and the bi-metallic strip variety, Pyroswitch, a volatile liquid expansion type which when adjusted for any critical temperature will sound an alarm or start a suction fan or other device to eliminate the dangerous condition. The industrial motor valves with electric motor drive and automatic shut-off will constitute a main feature of the display and are also new developments.

Representatives: R. L. Goetzenberger, Industrial Regulator department manager, in charge; M. C. Honeywell, H. W. Sweatt, C. B. Sweatt, W. L. Huff, A. P. Mudgett, George Kingsland, J. E. Haines.

Mixing Equipment Co., Inc.,
229 E. 38th St., New York, N. Y. Booths 279, 280

Models of "Lightnin" portable mixers, also Side angular-propeller-type agitators for tanks of any size will make up the exhibit in this booth. The mixers and agitators are arranged for convenient application to tanks, barrels, kettles and even large sized bottles and are arranged with telescope shafts and with double or single propellers as desired.

Representatives: F. L. Craddock, sales manager, in charge; C. H. King, D. R. McKillican, C. Donovan, W. J. Turnage.

Morrison Machine Co.,
204 Van Houten Ave., Paterson, N. J. Booths 209A, 210

Products here exhibited will be various sizes and models of speed reducing transmission, featuring a gear reduction unit with glass outer casing in operation to show the lubrication by means of a special arrangement. Other features will be right angle drive units and gear assemblies of different ratios. One of the new developments is the Hammar type tooth form gears and pinions designed to increase capacity of the unit and the quietness of operation.

Representatives: B. R. Atkinson, chief engineer; John Kreeft, John C. Morrison.

Morse Chain Co., Booths 263, 264
Ithaca, N. Y.

Moto Meter Co., Inc., Booths 622, 623
15 Wilbur Ave., Long Island City, N. Y.

Motoco industrial thermometers, pressure gages and recorders will be demonstrated in this exhibit. The thermometers show readings by a needle swinging over a large scale and this indicating device can be placed at any location so that temperature readings can be grouped on a central panel, readings being visible from 20 ft.

Representative: L. B. Murphy, industrial department.

Thomas E. Murray, Inc., Booth 64
55 Duane St., New York, N. Y.

Nash Engineering Co., Booth 66
So. Norwalk, Conn.

Nathan Manufacturing Co.
250 Park Ave., New York, N. Y. Booths 530, 531

Miscellaneous mechanical lubricators for stationary engines and locomotives, also brass and bronze castings, will make up this display. Specially featured will be the mechanical lubricators applied to various types of bearings and other parts to be lubricated, shown in actual operation. The construction with separate piston for each feed, with positive drive and with visual observation of the stroke or with sight feed will be demonstrated and the means by which any grade lubricant may be used against pressures up to 500 lb.

Representative: M. H. Potter.

National Acme Co., Booth 490
Cleveland, Ohio.

National Lead Co., Booth 258
111 Broadway, New York, N. Y.

National Tube Co., Booths 441-3
Frick Bldg., Pittsburgh, Pa.

Neckar Water Softener Corp., Booth 260
57 Wall St., New York, N. Y.

This company will feature a system of boiler feedwater treatment based on recirculation and continuous blowdown and will display typical flowsheets and photographs of their installations together with special valves and fittings used with the process.

Representative: C. C. Simoni, manager.

Neemes Foundry, Inc., Booth 56
206 First St., Troy, N. Y.

This company will exhibit a full size operating model of its Superior dumping grate, its Improved shaking and dumping grate and its Automatic stoker. Each of the exhibits will be so mounted that the entire mechanism will be accessible for examination. The grates are a recently developed type with mechanism designed for simplicity and compactness. The dumping grate will be arranged for operation by the interested visitor to show the ease of action and simplicity in replacement of parts. The shaking grates will also be arranged so that the visitor can investigate the action in service. In the stoker display, which will be fully operative, the uptake damper will be so connected that the automatic control and complete automatic operation of the mechanism will be clear. Improvements in the stoker since last year include simplification and compacting of damper control, compacting of gear reduction and motor unit, simplification of the coal feed adjustment, increase of the range of the adjustment available for coal progression, improvement in the manner of breaking up the coke bed and in the method of admitting over-fire air and a simplified and easier method of hand feeding in case of power failure.

Representatives: R. R. Rees, E. C. Welsh, A. B. Taylor, O. J. Vashrow, D. A. Campbell.

New York & Richmond Gas Co.,
Stapleton, S. I., N. Y. Booth 7

Northern Equipment Co. Booth 19
Erie, Pa.

The feature of this exhibit will be a working model of the Copes feed water regulator for high pressure service, showing the stabilization of water level by means of a gage glass and cut-away thermostatic expansion tube. Meters will show the steam flow and water flow and the valve body will be cut away to show the actual valve operation. The Copes dial type valve movement indicator will show the amount of the valve movement. Other features of the display will be the type RG combined feed flow water pressure regulator, type SS differential water pressure regulating valve, and type DS pump governor, all with bodies cut away to show construction and operation. Type CRI orifice discharge valve and the tripper type thermostat used for high pressure condensate drainage will also be shown.

Representatives: E. W. Nick, president; V. V. Veenschoten, C. E. Wolff, Jr.

Oakite Products, Inc., Booths 419, 420
22 Thomas St., New York, N. Y.

Okonite Co., Booth 619
501 Fifth Ave., New York, N. Y.

Samples of Okonite rubber, varnished cambric and paper insulated super high-tension power cables will be shown, also friction and rubber insulated tapes, portable cords and flexible power cables.

Representatives: J. D. Underhill, sales manager; R. J. Johnson, C. Neudoerffer, W. W. Fleming, J. M. Bellavigna.

Parker Appliance Co., Booths 655, 656
Cleveland, Ohio.

Complete line of Parker tube couplings and associated equipment will be displayed including standard and double extra heavy fittings in brass, bronze, steel, monel metal and duralumin. Triple extra heavy couplings will also be shown for very high pressure heavy-duty service. A feature of the exhibit will be complete tube fabricating equipment, including particularly tube benders, both hand and production type, demonstrating the bending of copper tubing. Flaring tools will be displayed and demonstrated, also globe valves, taper plug valves, needle valves and other types machined to Parker tube coupling standards. One feature will be an assembled draft meter manifold, designed for ready flow down of draft lines without breaking connections and providing drainage of oil accumulating in the meter lines to eliminate danger of introducing pressure into the draft meters.

Representatives: C. E. Klamm, in charge; William F. Rapprich, Jr.; A. L. Parker.

Peabody Engineering Corp., Booth 46
110 E. 42nd St., New York, N. Y.

For the first time a recently developed high capacity combined gas and oil burner will be displayed, designed along the same lines as the company's standard burner. This has been developed for use in the oil industry to fire vertical, circular pipe stills using 1000 to 3500 lb. of oil an hour per burner or its equivalent in gas. They can be installed to fire vertically downward or vertically upward. In addition will be shown for the first time a combined oil, gas and pulverized coal burner, which has been in use for some time but has not been exhibited. The different

fuels can be burned separately or in combination with the same ease as for a single fuel.

Representatives: A. P. Olches, R. C. Vroom, C. S. Hempstead, E. A. Niemeyer, E. G. Peterson, E. H. Peabody, D. P. Graham.

Peerless Electric Co., Booths 483-4
Warren, Ohio.

Electric motors of standard and special design, also a number of fans for office use and for exhausting air from rooms or buildings will be displayed. Other features will be furnace fans, a flexible shaft grinder and as a special feature several motor-driven machines manufactured by customers and using Peerless motors of special design.

Representatives: Ralph Kroehle, president; A. F. Chamberlain, New York manager, in charge.

Pepin No-Jar Clutch Co., Booth 641
67 Third Ave., Lowell, Mass.

Automatic Nojar clutch will be shown.

Representative: Nelson J. Pepin.

Permutit Co., Booths 348, 444
440 Fourth Ave., New York, N. Y.

The principal and most interesting exhibit of this company will be a model of water softening and filtering equipment as used in industrial plants, displayed in booth 348. The model is some four feet long and made exactly to scale after a large commercial unit which delivers 100,000 gal. per day. The company will also show Ranarex instruments for recording carbon dioxide gas density, ammonia gas and other features in booth 444, the operation of the instruments being demonstrated as well as their construction.

Representatives: H. D. Harger, G. Kaiser in charge of booth 444. H. M. Olson, Pittsburgh; D. J. Hess, Philadelphia; J. S. Shedden, E. Dando, New York, in booth 348.

Philadelphia Gear Works, Booth 13
Philadelphia, Pa.

Pipe-Saver Corporation of America,
Carthage, N. Y. Booth 446

Pipe Savers will be displayed here, the main feature of the exhibit being a section of piping taken from plants where pipe savers have been in actual service over a period of two years. A new product displayed will be a chromium plated pipe saver recently brought into the market for use where electrolysis is feared, also savers for extra heavy pipe and demonstration of just how Pipe Savers are installed.

Representatives: J. L. Strickland, secretary; J. H. Wall, Charles Widemeyer, C. L. French, H. S. Lewis.

Pitts and Kitts Manufacturing & Supply Company, Booth 275
91 Seventh Ave., New York, N. Y.

Products here shown will include Pero Plaz plastic fire brick, Plastikote boiler wall covering, reducing valves, traps, float and balance valves, auxiliary operating valves, temperature regulators for liquids, thermostatic control for rooms and the Hill pump valve.

Representatives: J. R. Hughes, president; S. Weinik, vice-president; J. V. Garneau, sales manager; W. J. Hayes, J. S. Schaul, district representatives.

Pittsburgh Coal Co., Booth 319
Pittsburgh, Pa.

Pittsburgh Piping and Equipment Co.
43rd St. and A. V. R. R., Pittsburgh, Pa. Booth 434

Especially emphasized at this exhibit will be the Pittsburgh Piping Creased bend, which, by special construction, permits the use of a much smaller bend with saving in space and decrease in heat losses. Creases are formed on the inside arc of the bend, full thickness of wall material being maintained on both the inside and the outside of the bend.

Representative: Duncan G. Sinclair.

Plibrico Jointless Firebrick Co., Booth 92
1800 Kingsbury St., Chicago, Ill.

Here will be found a model of a horizontal return tubular boiler approximately half size, showing the installation of a Plibrico front arch and sidewall. In addition there will be displayed samples of the company's exclusive Flexo anchor for tying lining to the steel casing or outer brick work while permitting it to move with expansion and contraction. Descriptive literature and a model of a Plibrico-backed water wall furnace will also be shown.

Representatives: I. S. Pieters, vice-president; C. A. Werner, New York manager; R. L. Woodward, New York.

Wm. Powell Co., Booths 344, 345
Cincinnati, Ohio.

A complete line of bronze, iron and steel globe, angle, check, gate and safety valves will be shown, as well as special valves of various types. The main features of the exhibit will be steel valves for power plant service; also quarter and half sections of the principal valves will show the details of construction of the working parts.

Representatives: William Heilig, James Coombe, E. R. Noll, William C. Hust, George T. Bloom.

Powers Regulator Co., Booths 283, 284
2720 Greenview Ave., Chicago, Ill.

Prat-Daniel Corp. Booths 26, 26A
183 Madison Ave., New York, N. Y.

This company will show its entire line of Thermix products including plate type air heaters, stream-line stacks and cinder eliminating fans and stacks. The main features will be a type IV cinder eliminating and dust collecting fan in operation, showing stacks of different types covering all ranges of operating conditions and exhibits with the detailed construction of apparatus. New features and improvements will include the cinder eliminating and dust collecting fans, also an improved type of fan and rotor of special design for high drafts and designed for minimum wear.

Representatives: Louis C. Whiton, Jr., president; M. B. Carroll, general sales manager; John E. Watson, H. L. Parry, A. B. Carle.

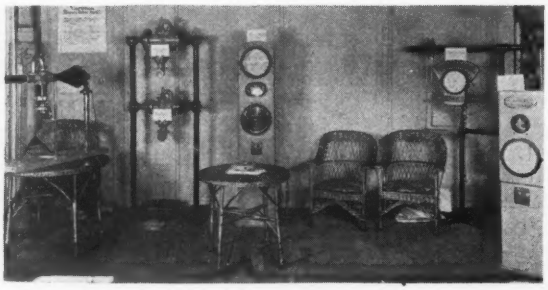
Pratt & Whitney Co., Booth 631
Hartford, Conn.

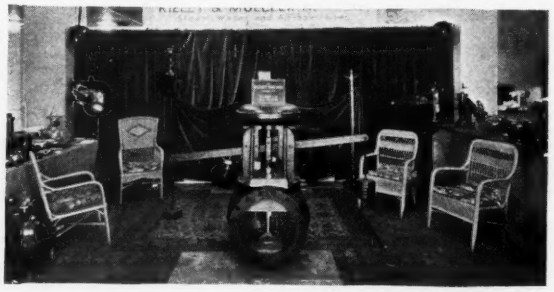
This company's display will comprise a No. 1A jig borer complete with attachments and tool cabinet as well as the Hoke precision gages with thread and cylindrical gages of various styles. Another feature will be the iron plates known as Eight Pieces of Iron to illustrate the accuracy of the jig boring machine.

Representative: R. A. Burbank, advertising department.

Preferred Utilities Co., Booths 304, 305
33 W. 60th St., New York, N. Y.

Booth 303 will be used for the display of the Hart oil burner mounted on a triple service boiler. Booths 304, 305 will be used for the Ray fuel oil burner in all its types and models.





Representatives: G. H. Rittenhouse, H. S. Downe, G. W. Bohn, P. Constant, F. H. Fowler, W. A. Johnson, G. P. Gregory, Hart oil burner; B. K. Breed, B. G. Kaufman, F. H. Pennington, R. S. Bohn, A. Roberts, J. S. Kaplan, G. T. Williams, E. B. Lipsett, Ray oil burner.

Pyrometer Instrument Co., Booth 202
50 Howard St., New York, N. Y.

Quigley Furnace Specialties Co., Booth 89
56 W. 45th St., New York, N. Y.

Here will be found Hytempite, Triple-A protective coatings, Quigley refractory gun and Quigley acid-proof cement. A special feature will be a mechanical exhibit showing the resistance of Triple-A coatings to acids and alkalies, also an exhibit of Triple-A coatings in colors, resistant to the action of alcohol, oil, grease, benzine and like liquids.

Representatives: W. S. Quigley, president; W. H. Gaylord, Jr., vice president; J. H. McPadden, sales manager; L. P. Kellogg, manager Triple-A division; H. T. Matthew, advertising manager; C. C. Gantzman, M. F. King, D. F. McMahon, H. M. Miller, S. F. Murphy, E. L. Bassett, W. L. Parker, F. J. Spillane, service engineers; Robt. Walker, general manager, Quigley Co. of Canada.

Rawlplug Co., Booth 539
66 W. Broadway, New York, N. W.

Rawlplugs, a device of jute fiber to anchor screws into holes by expansion of

the plug throughout its length, and Rawldrills for fast drilling in masonry will make up this display. A new product to be shown will be the Crowner, an ornamental cover for protection of screw heads.

Representative: H. G. Janton, exhibit manager.

Reading Steel Casting Co., Booths 634, 635
Bridgeport, Conn.

Products to be shown will include a steel valve of each series from 15 up to and include 135, a motor-operated gate valve, a complete new line of extra heavy bronze globe valves and a line of new type needle valves and air specialties. Main features will be the new extra heavy bronze valves and needle valves.

Representatives: W. McCausland, general manager sales; John C. Storrs, sales engineer, in charge; J. P. Ferguson, sales engineer; A. R. Whitcomb, sales promotion department; W. D. Cashin, Boston; H. L. Leon, Charlotte, N. C.; H. H. Freund, Jr., Philadelphia; J. F. Smith, Rochester, N. Y.; A. W. Taggart, Pittsburgh; E. C. Magens, N. Y.

Realty Paint Sales Co., Booths 464, 465
205 E. 42nd St., New York, N. Y.

Paints and varnishes will make up this exhibit, the main features being paint for domestic, industrial and marine use. A new product shown will be quick drying oil proof enamel and Realac varnish.

Representatives: H. C. MacArthur, A. G. Burke, E. L. Smith, A. G. Terwilliger.

Reeves Pulley Co., Booths 34, 35
Columbus, Ind.

Improved modern design of Reeves variable transmission will be exhibited including remote electrical control for the Reeves transmission to operate any machine on conveyor from a distant point by means of a push button. One or more stations can be used and speed regulation can be controlled over a wide range.

Representatives: C. M. Reeves, vice president; H. B. Diehl, E. S. Redmerski, H. W. Randolph; D. W. Clem, New York manager, in charge.

Refractory & Engineering Corp.,
50 Church St., New York, N. Y.
Booths 25, 25A

Complete line of refractory cements will be shown as well as their application for furnace construction and repair.

Representatives: H. N. Clark, C. P. F. Waidler, Frank Christenson, R. H. Wheeler.

Reliance Electric & Engineering Co.,
1042 Ivanhoe Rd., Cleveland, Ohio.
Booths 542, 543

Products to be shown in this display will be alternating-current motors including a 1-hp. with ring base for vertical operation and a 25-hp. squirrel cage type; direct-current motors include a 15-hp. heavy duty and a 20-hp. motor with semi-enclosing and fully-enclosing covers; a 5-hp. fully-enclosed motor and a 3½-kw., a.c.-d.c. motor generator set on welded base. As a special feature will be demonstrated the enclosure of fan-cooled motors for locations where there is much dirt, chips or moisture, to protect the windings from deterioration. Demonstration will be made of the wide speed-range drive ranging from a few turns per minute to the maximum permissible by the motor rating.

Representatives: J. W. Corey, sales manager; C. L. Peterson, advertising department; R. H. Smith, Boston district sales manager; C. D. Herbert, New York sales manager; J. W. Picking, New York representative; E. E. Helm, district manager; E. A. Clark, representative, Philadelphia.

Richardson Scale Co., Booths 14B, 15B
Clifton, N. J.

Full size Richardson apron feed automatic crushed coal scale will be displayed of hopper type with endless feeder built in. Also a full size Convey-O-Weigh, an automatic scale to control the supply of materials, weigh them onto a weighing conveyor, to deliver an elongated stream as from one conveyor to another, stopping and starting the feeder at the completion and commencement of each weighing. By using a scale for each ingredient, intimate, carefully proportioned mixtures may be made as fed to the conveyor.

Representatives: William F. Cohn, in charge; C. R. Clark, New York manager; E. A. Matthews, Philadelphia manager; E. C. Mott, Atlanta manager.

Riley Stoker Corp., Booths 78, 79
Worcester, Mass.

Products shown here will include a complete Jones stoker unit with Riflex drive, an improved Riley Atrita unit pulverizer, the latest type Riley flare burner and a section of Riley-La Mont water wall.

Representatives: Robert J. Kruger, advertising manager, in charge; L. E. Griffith, sales manager and vice president; J. W. Armour, engineering manager and vice president; J. H. McElroy, superintendent.

Robins Conveying Belt Co. Booth 514
15 Park Row, New York, N. Y.

Working models of Robins Gyrex screen and stone grizzly will be shown, also rubber squeegee cleaner for conveyor belts, and troughing idlers with Timken bearings, a new product this year.

Representatives: J. H. Robins, H. Von Thaden, R. H. Dana, F. J. Tuite, T. M. Keith, W. L. Fewsmith, advertising manager.

Roller-Smith Co., Booth 603
233 Broadway, New York, N. Y.

This company will exhibit its switchboard and portable type electrical measuring instruments, including graphic styles for alternating and direct current. Relays of different types will be shown, also representative types of air and oil circuit breakers. Special features found in this booth will include electrically operated oil and air circuit breakers mounted on panels with instruments and accessories to show method of operation. These breakers are new products and will embody many improvements over manually operated devices.

Representatives: G. L. Crosby, vice president; C. G. Kahant, S. H. King, W. J. Shire, New York office.

Rome Brass Radiator Co., Booths 447-9
1 E. 42nd St., New York, N. Y.

Robras radiators of various types, also encased units for fan work and a new device, the Aulbras water heaters, will be displayed.

Representatives: J. D. Erskine, J. A. Swan, D. L. Mills, D. G. Noakes, T. E. Crone.

Roto Co., Booth 11
Newark, N. J.

Tube cleaners for boilers, condensers, evaporators, oil stills, locomotives and other tubular apparatus will be displayed, also boiler-hand-hole-seat scrapers and cap cleaning machines. A special feature of the exhibit will be the demonstration of a cap cleaning machine in operation.

Representatives: W. M. Kelley, J. V. Doherty, sales engineers.

Rotor Air Tool Co., Booth 653
5704 Carnegie Ave., Cleveland, Ohio.

This company will exhibit its complete line of portable air tools, including drills, grinders, sanders and buffers with various attachments.

Representatives: K. L. Pohlman, vice-president; G. O. Singer, New York; A. T. Moulton, Philadelphia; P. R. Gang, Boston; C. B. Scott, Cleveland.

Joseph T. Ryerson & Son, Inc.,
Chicago, Ill. Booth 433

Iron and steel commodities, including rolled sections, bars, structural shapes, also Allegheny metal, Babbit metal, small tools, machinery grating, reinforcing material and other items required by users of steel will be exhibited.

Sarco Company, Inc., Booth 33
183 Madison Ave., New York, N. Y.

This company will show various types of steam traps for industrial work, standard and special temperature regulators for hot water service tanks, industrial processing, dry kilns and the like. There will also be shown a line of regulators for refrigeration work suitable for temperatures from 0 deg. upward. As a special feature will be included the complete Sarco heating line including inlet valves, thermostatic traps, blast traps, air eliminators and other apparatus for low-pressure, vacuum and vapor heating systems.

Representatives: E. J. Ritchie, R. W. Cumming, E. E. Wells, R. C. Doerr, F. L. Sudhop.

Sauerman Bros., **Booths 564-69**
438 S. Clinton St., Chicago, Ill.

Model equipment of a typical coal storage layout will be shown here with the Sauerman Crescent power scraper stocking out and reclaiming coal. Also will be shown a model equipment for sand, gravel and stone, typical of installations used for these and similar materials. In the sand and gravel equipment, operation of an elevated bridle to shift the operation of the scraper will be demonstrated. Both equipments will show the use of the Crescent scraper, electric hoists, operating cables and blocks necessary for a complete installation, the sand and gravel model being equipped with duplicates of the latest Durolite blocks.

Representatives: D. D. Guilfoil, vice president and general sales manager; J. A. Schultz, in charge; H. M. Cooper, New York representative.

W. J. Savage Co., Inc., Booth 654
Knoxville, Tenn.

Two Gray metal cutters will be shown in operation with all the latest features including the new toolholder assembly and the tripod cutting table, which are special features.

Representatives: W. H. Obenour, president and general manager; J. L. McKay, assistant to the president and general sales manager; T. S. Harbison.

Sayre & Fisher Brick Co., Booth 489
Sayreville, N. J.

Schutte & Koerting Co., Booth 616
Philadelphia, Pa.

Here will be found power plant equipment and some industrial process appliances, the main features being high-pressure steam valves, herringbone gear pumps for oil, and SK products with special construction features.

Representatives: Messrs. Ellis and

Ulbert, New York; Messrs. Derby, Heinemann, Hellmer, Murdock, Loescher, Ketterer and Woodward, factory sales engineering department.

Schweiger Furnace Corp., Booth 211
50 Church St., New York, N. Y.

Scoville Mfg. Co., Booth 69
Waterbury, Conn.

Sharples Specialty Co., Booth 45
23rd & Westmoreland Sts., Philadelphia, Pa.

Here the company will exhibit its Presurtite, a totally enclosed oil purifier, and its cross-sectioned machine showing the different parts of the centrifuge to advantage. Also will be shown a laboratory model and a small horizontal machine embodying the latest developments. This latter will be the special feature of the exhibit, the small machine being a replica of the largest horizontal type which is used extensively for drying of ammonium sulphate.

Representatives: H. H. LaMent, vice president and sales manager, in charge; B. B. Davidson, New York manager; J. E. Paul, Philadelphia manager; E. M. James, chief chemist.

Shepard Niles Crane & Hoist Corp.
Montour Falls, N. Y. Booth 231

New compact hoists in operation and a series of display frames containing tinted enlargements of installation views and portrait views of the company's equipment will be displayed.

Representatives: R. T. Turner, sales manager; A. J. Barnes, Roy W. Hurst, Roscoe C. Vaughn.

Signal Engineering & Mfg. Co., Booth 547
154 West 14th St., New York, N. Y.

Magnetic relays for all applications, electrically operated audible signals in all types, complete Signal Call code system for industrial plants and interior fire alarm system adaptable to industrial installations will make up this exhibit.

Representatives: J. H. Wheelock, treasurer; T. F. Herring, general sales manager; F. L. Garrigues, district sales manager; C. A. Claus, sales engineer.

Silent Hoist Winch & Crane Co., Inc.,
762 Henry St., Brooklyn, N. Y.
Booths 548, 549

Silent Hoist power winches for motor trucks, electric winches and hoists, electrical car puller and barge mover, boat hoist, worm gear speed reducers and Silent telescopic hoists for ash removal will be shown. Main features of the exhibit, including new features and improvements, will be the worm geared electric car puller and the telescopic hoist with single lever control and automatic stops.

Representatives: J. W. Wunsch, president; Samuel Wunsch, secretary; F. K. Flynn, engineer.

Simplex Valve & Meter Co., Booth 76E
68th & Upland Sts., Philadelphia, Pa.

Simplex Venturi-type meters for measuring boiler feed, condensate, make up water and the like will be shown, especially adapted for modern high temperatures and pressures.

Representatives: M. M. Borden, general manager; Roy Morrison, service engineer; Hubert B. Smith, sales manager; W. K. Sowdon, New York representative.

D. H. Skeen & Co., Booth 31
1362 Monadnock Block, Chicago, Ill.

F. L. Smidth & Co., Booth 318
225 Broadway, New York, N. Y.

Smith & Serrell, Booths 85, 86
Globe Indemnity Bldg., Newark, N. J.

Snap-On Wrench Co., Booth 612
14 E. Jackson Blvd., Chicago, Ill.

W. K. Sowdon & Co., Inc., Booth 76
342 Madison Ave., New York, N. Y.

Spencer Turbine Co., Booths 452, 453
Hartford, Conn.

Pneumatic sweeping equipment for power and industrial plants will be demonstrated, also a slow speed multi-stage vacuum cleaner with separator and line of hose and cleaning implements. A 10-hp. turbo-compressor will be operated as used to supply moderate-pressure air for oil and gas-fired furnace and foundry cupolas.

Representative: F. A. Wright.

Square D Co., Booths 613, 614
6060 Rivard St., Detroit, Mich.

Manually operated safety switches, a complete line of automatic control apparatus, lighting panels, power panels, Square-Duct and voltage testers will be the products on display at this exhibit. A special feature will be a new narrow type lightning panel, 12 in. wide, to permit installation on columns; moulded bakelite used for interiors; interchangeable plug and cartridge sections.

Representative: W. J. Wickenheiser, branch sales manager, in charge.

Standard Oil Co. of New York,
230 Park Ave., New York, N. Y.
Booths 207-9

This company will display its Socony industrial lubricants, including Diesel engine oils, turbine oils, steam cylinder oils, engine and machine oils, cutting tempering and other industrial oils and greases as well as oils for lubrication of motor cars and fuel oils for Diesel engines and industrial plants.

A miniature refinery will be operated showing the manufacturing processes involved in the production of these oils and greases. New development during the past year is a line of Diesel engine oils known as the Turex, designed particularly for lubrication and non-carbon forming properties. Also a new line of steam cylinder oils known as Cylbrex for handling difficult lubricating problems.

Representatives: F. G. Atlee, sales manager, S. W. Mudge, assistant sales manager, lubricating oil department (in charge of booths); N. C. Butler, Jr., E. J. Milligan, lubricating engineers; L. A. Herrmann, cutting oil and core oil specialist; J. R. Robbins, lubricating oil department.

Star Expansion Bolt Co., Booth 302
147 Cedar St., New York, N. Y.

L. S. Starrett Co., Booth 456
Athol, Mass.

Precision instruments, including micrometers and vernier calipers, also steel tapes, tungsten hacksaw blades, machinists' vises and a new line of gages covering depth, thickness and cylinder curvature will be found in this booth.

Representatives: W. J. Greene, manager; G. R. Christie, T. B. Hogben, W. J. Clark, H. Christensen, A. S. Collins, W. B. Landis.

Sterling Engine Co., Booth 50
1270 Niagara St., Buffalo, N. Y.

Stevens Walden Worcester, Inc.,
475 Shrewsbury St., Worcester, Mass.
Booth 642

Stockham Pipe & Fittings Co.,
Birmingham, Ala. Booths 556-7

Products displayed will consist of the Stockham Fantz type return bend and samples of every type of fitting which the company makes. Specially featured will be the return bend, shown on a special stand to demonstrate the application of this product. The U piece joined to tube ends by ring joint and held in place by a yoke makes replacement and inspection simple.

Representatives: A. W. Hale, eastern manager; M. B. Crowe, manager petroleum division; C. S. Coleman, manager New York warehouse.

Strong, Carlisle & Hammond Co.,
1392 West Third St., Cleveland, Ohio.
Booth 413

Strong steam specialties shown here will include traps, pressure regulating valves, reducing valves, Evrtyte globe valves, boiler stop and check valves, automatic engine stops and allied products. For the first time will be shown the Strong inverted bucket forged steel trap suitable for pressures up to 1800 lb., also the Strong balanced type and super sensitive type reducing valves.

Representatives: L. P. Strong, R. L. Clark, J. N. Warren, H. B. Piatt, L. A. H. Merrihew, W. O. Clark.

Struthers Dunn, Inc., Booth 520
1130 Race St., Philadelphia, Pa.

Sturtevant Mill Co., Booth 44A
Harrison Sq., Boston, Mass.

Sumet Corporation, Booth 510
1543 Fillmore Ave., Buffalo, N. Y.

Sumet bronze bearings in operation, dry at 550 deg., in steam and in water; rough and finished bearings, drawn rods, new processes just developed.

Representatives: W. J. Dugan, vice president and general manager; H. O. Warner, sales manager; A. A. Matthews, sales engineer.

Sundh Electric Co., Inc., Booths 435, 436
Parkhurst St. at Avenue C, Newark, N. J.

This display will consist in general of representative apparatus chosen from the company's standard line covering types of control particularly adapted for use in New York City.

Representative: P. W. Moeller, New York.

Superior Die Casting Co., Booth 606
875 E. 70th St., Cleveland, Ohio.

Die castings covering a wide range of uses from toys to tractors and made of super cast alloys of zinc, tin, lead and aluminum base will be exhibited. Of particular interest will be the intricacies of the various forms, the accuracy and the finish and sharp outlines secured by this method. Tests will be shown of the torsion and strain of the casting. Aluminum die castings of many kinds will be displayed showing the accuracy and intricacy which can be worked out in the die-cast method, as applied to the parts of many machines used in everyday life.

Representatives: H. H. Weiss, president; B. M. Halpern, D. J. Gibson, sales engineers, New York office; C. F. Rubin, sales engineer, Cleveland.

Alfred Suter, Booth 479
200 Fifth Ave., New York, N. Y.

Machines will be shown here for testing the balancing of small rotors, these machines being displayed for the first time in this country. Also there will be demonstrated drilling methods and the ball test for the hardness of materials.

Representatives: Alfred Suter, H. D. Herman.

Swartwout Co., Booth 75
103 Park Ave., New York, N. Y.

Products exhibited here will consist of the feed water regulator, type SLP variable excess pressure regulator, master controlled pressure reducing valve, drainage control, exhaust head, steam separator, air separator, high pressure bucket and low pressure float traps, differential type pump governor, and rotary ventilator with automatically controlled dampers. As a special feature will be shown a working exhibit of the company's latest type of feed water regulator in combination with their type SLP variable excess pressure regulator.

Representatives: H. S. Fraser, eastern sales manager; L. V. Warner, sales manager, steam division; J. W. Johnson, P. R. Jones, New York.

Sweet & Doyle Foundry & Machine Co.,
Green Island, N. Y. Booths 227, 228

C. J. Tagliabue Mfg. Co., Booth 59
18 33rd St., Brooklyn, N. Y.

TAG recorders in new round form case, of flush and wall mounted types, round form controllers of non-indicating and indicating types, automatic steam-operated controllers, automatic recorder controllers and other instruments of special interest for power plants will be exhibited. Among these will be industrial thermometers with TAG-Hespe feature, recording pressure gages, pyrometers, absolute pressure gages, U-gages, etched stem thermometers and hydrometers. A special feature will be instruments for conducting the A. S. T. M. oil test for both lubricants and fuels.

Representatives: Victor Wichum, chief engineer; H. D. Cooke, general sales manager; E. E. Corbett, P. R. Wilhelm, division sales managers; W. C. Begeebing, assistant chief engineer; L. M. Hachenberg, A. C. Homeyer, O. C. Etterwendt, sales engineers; A. Traudt, Jr., engineering department; M. Malone, service department.

Webster Tallmadge & Co., Inc.,
50 Church St., New York, N. Y.
Booth 416

Taylor Instrument Cos., Booth 601
Rochester, N. Y.

Products to be shown here will be indicating and recording thermometers, temperature and pressure regulators, mercury column vacuum gages and mercurial barometers, thermometers of industrial and glass-engraved-stem types, also test wells for laboratory and general power plant testing, indicating and recording thermo-electric pyrometers. New features and improvements to be shown will be hardened steel springs for recording pressure gages and thermometers to insure permanency of calibration.

Representatives: J. W. Schwarz, manager industrial thermometer and thermo-electric pyrometer department; C. B. Carson, manager recording thermometer department; H. W. Kugler, W. N. Maurer, J. P. Gilmore, W. J. Marlborough, New York; L. B. Swift, chief engineer.

Texas Co., Booths 460, 461
17 Battery Place, New York, N. Y.

In this display will be found gear lubricants, oils for turbines, refrigeration machinery and general power plant use. A display will be made of oils under actual operating conditions, showing the power saving through correct lubrication.

Representatives: G. R. Rowland, supervising engineer; C. R. McCarthy, superintendent of national sales; F. C. Kerns, superintendent of sales; N. M. Aycock, assistant superintendent of sales, northern territory; R. Haskell, A. V. Richie, A. F. Brewer, industrial chemists; Wm. Harrigan, J. G. Strand, S. V. Davison, W. S. Nicholas, automotive engineers; W. L. Kallman, district manager, H. S. Gruet, W. Hochuli, assistant managers, New York; D. L. Keys, J. F. Lamb, territorial engineers; T. C. Dick, C. E. Kinser, C. J. Dowe, Wm. Dotten, lubrication engineers; A. H. Jantzen, F. J. Campbell, electric railway engineers; O. F. Siebener, M. H. L. Sullivan, E. Ebell.

Thomas Grate Bar Co., Booth 276
Birmingham, Ala.

Products to be shown will include Thomas grate equipment consisting of the WSD, or Wiggling-Shaking-Dumping, grates for burning coal, coke, small anthracite and mixtures of these fuels; also Elliptic and Durable stationary grates. Special features shown will be complete working models as well as full size castings showing the details of construction and operation. Improvements to be found will be structural details adapting the grates for burning all grades of coal in all types and sizes of fire boxes.

Representatives: E. A. Thomas, president; Edgar Johnston, Grant L. Thomas.

Tide Water Oil Sales Corp., Booth 15A
11 Broadway, New York, N. Y.

A complete line of petroleum products designed to meet the requirements of industrial and power equipment will be shown, the main features being a display of lubricants and the motion picture of plant lubrication.

Representative: S. D. Brunt, in charge.

Time-O-Stat Controls Co.,
Elkhart, Ind. Booths 306, 307

Timken Roller Bearing Co.,
Canton, Ohio. Booths 332, 333

Toledo Pipe Threading Mach. Co.,
Booths 411, 412
1425 Summit St., Toledo, Ohio.

Complete line of pipe threaders, cutters, reamers, vises and vise mounts will be shown, also the company's power drives and portable pipe threading machines. The newest thing on display will be the No. 999 portable power pipe machine for cutting and threading in sizes from ½ in. to 2 in.

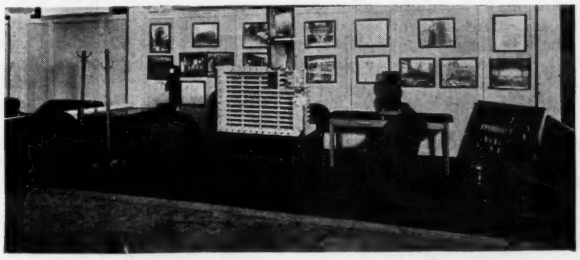
Representatives: Clarence A. Popp, eastern manager of sales, in charge; Waynard Vosper, F. D. Stuart, Wm. J. McGrath, J. E. Booth.

Topping Brothers, Booths 288-90
159 Varick St., New York, N. Y.

Trane Co., Booths 252, 253
LaCrosse, Wis.

Concealed heaters, unit heaters, pumps and specialties will be the products shown in this display. Main features of the exhibit will be heaters which will be shown in detail and their application demonstrated.

Representatives: M. Wm. Ehrlich, New York, in charge.



H. O. Trerice Co., Booth 267
1338 W. Lafayette Blvd., Detroit, Mich.

Troy Engine & Machine Co., Booth 555
Troy, Pa.

A small steam engine will be displayed so as to show the automatic lubricating system and other advantages of the company's design.

Representative: A. R. McMahon.

Trumbull Elec. Mfg. Co., Booth 3-M
114 Liberty St., New York, N. Y.

Tube-Turns, Booths 405-406
Shelby St. and Goss Ave., Louisville, Ky.

Tube-Turns which will be on display are a seamless drawn fitting for pipe welding and will be featured in various installations, the application being shown by the use of models.

Representatives: R. E. Fritsch, vice-president; Nate Lord, advertising manager; W. P. Curley, New York representative.

Universal Gear Corp., Booths 617, 618
327 S. La Salle St., Chicago, Ill.

Here will be shown Heliocentric speed reducers for change of speeds from 10 to one up to several hundred thousands to one and in sizes up to 20 hp. Other features will be Pitter clutches with variable ratchet arm and positive infinitely variable gear reduction. The speed reducer built into the end frame of an electric motor and the variable stoker gear will be shown in operation, also a speed reducer of great reduction. All these devices are shown in this country for the first time, being inventions of Walter Charles Pitter of London, England. The 20-hp. variable reduction gear is designed primarily for stoker drive although adaptable for other purposes and has input speed of 1200 r.p.m. with output speed from zero to 90 r.p.m.

Representatives: Fred M. Potgieter, in charge; Walter Charles Pitter, W. C. Hopkins, J. E. Groff.

Van Dorn Electric Tool Co.,
Cleveland, Ohio. Booths 512, 513

Portable electric drills, screwdrivers, tappers, nut setters, grinders, portable flexible disc sanders and electric hammers for operation on a.c. or d.c. current, high frequency tools, floor and bench type grinders and valve refacers will be displayed. A special feature will be the recently announced ½-in. drill and drill stand, also electric socket wrench for running up and removing nuts and as a main attraction the latest development in high frequency tools, new vertical trolley column and high frequency motor for setting or driving nuts.

Representatives: R. W. Procter, sales manager; S. S. Waters, manager industrial sales; L. L. Chanicky in charge of small tool and accessory sales; R. G. Horner, New York district manager; H. B. Austin, Philadelphia district manager.

Veeder-Root Inc., Booth 234
Hartford, Conn.

Products to be shown here will be counting machines, including a table exhibiting a general line of counters, magnetic counters, small counters, heavy duty counters, and as special features the counting of drops of water and magnetic counter registering when the finger is pointing towards it. The new high speed counter with improvements will be shown for the first time.

Representatives: John H. Chaplin, Arthur E. Kallinich, David J. Post, Jr., Joseph T. Quinlan, Douglas J. Ogilvie.

Henry Vogt Machine Co., Booth 266
Louisville, Ky.

Products shown in this exhibit will be D. F. steel valves and fittings which will be specially featured.

Representatives: W. S. Cannon, Jr., R. F. Woolf.

Walworth Co., Booths 477, 478, 491, 492
Statler Bldg., Boston, Mass.

Four main lines of products will be shown by this company including Sigma steel valves and fittings for high pressure and high temperature steam service, bronze valves, chrome-nickel-iron pipe and Stillson wrenches. The Sigma valves will be shown in section form, mounted on roller bearing swivel stands for easy examination of working parts. Bronze valves will include the complete line of steam valves for pressures from 150 to 300 lb. and the pipe exhibit will be a demonstration of welded lengths of cast chrome-nickel-iron pipe and chrome-nickel-iron fittings. A test of the strength of the Stillson wrench will be demonstrated.

Representatives: Messrs. Keane, Morehead, Duemler, Stevens, Scanlon, Cole, Schwerin, Titus.

Warren, Killion & Clark Co., Booth 413
30 Church St., New York, N. Y.

Warren Webster & Co., Booths 225, 226
Camden, N. J.

Products to be shown include Webster vacuum system, type R system and moderator system of steam heating.

Representative: B. F. Lerch, assistant advertising manager.

Watts Regulator Co., Booth 39
250 Lowell St., Lawrence, Mass.

This company's U-Tube heat interchanger, auxiliary pressure regulator, pressure reducing valves, pressure and damper relief valves, pump governors, hot-water heating units and water-pressure reducing valves will be shown. Actual demonstration will be made of the operation of the Type 40 temperature pressure relief valve for hot water heating systems.

Representatives: B. E. Horne, Charles C. Phelps, H. C. Schmidt.

Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa. Booths 68, 564, 565

In booth 68 will be found a working model of a link-grate, multiple-retort stoker of the latest design for large boilers and heavy sustained loads as used in such stations as Hudson Ave., Read and Sayreville. Operation of the undulating overfeed section which constitutes from ¼ to ½ the stoker area will be demonstrated.

Booths 564 and 565 will contain an exhibit of a 150-hp. steam turbine for mechanical drive of centrifugal circulating and boiler feed pumps, blowers and other rotary auxiliaries. Drive may be direct or through reduction gears. Construction details will be shown such as forged steel disc with nickel steel impulse blading, speed and emergency governors, horizontally split casing with all connections on the lower half, water-sealed glands, nozzles and reversing chambers.

Weston Electrical Instrument Corp.
Newark, N. J. Booth 600

A representative group of electrical indicating instruments for a.c. and d.c. in both portable and switchboard types will be shown here. A special feature will be a set of miniature a.c. testing instruments, also the new Weston model 539 portable current transformer.

Representatives: L. C. Nichols, H. L. Gerstenberger, W. G. Long, A. F. Wolferz, C. B. Denton.

C. H. Wheeler Manufacturing Co.,
Lehigh & Sedgley Aves., Philadelphia, Pa. Booth 77

This company will display a model of the Radojet air pump, also a two-stage air pump with combined inter and after-condenser. Drawings of modern tube sheet layout for dual-bank-type surface condensers will be shown and photographs of the company's various products.

Representative: Mr. Dobson, in charge.

Wheland Co., Booth 295
Chattanooga, Tenn.

Williams Tool Corp., Booths 567, 568
Erie, Pa.

Williams Rapiduction pipe threading and cutting machine of capacity 1 to 6 in. will be shown here for cutting both right and left hand threads. It is chain driven with six speed changes and will be shown in operation. Other features will be a new line of Wilco pipe threading machines in capacities ½ to 4 in. with four speed changes and a portable pipe threading machine with capacity of ¼ to 2 in., which can, by special drive, thread pipe up to 8 in.

Representatives: C. E. Glick, engineer; D. Moreinis, district manager; L. K. Warman.

L. J. Wing Mfg. Co., Booth 61
154 W. 14th St., New York, N. Y.

Products displayed by this company will include a turbine blower for forced draft, for either stokered or hand-fired boilers, steam turbines of capacity up to 60 hp. for driving pumps, fans and the like, centrifugal turbine blower for gas producers, compressed air driven turbine blower for mine ventilation, motor-driven forced draft blower for low pressure boilers, Wing Scruplex fan for ventilating and Scruplex exhauster and fog eliminator, Wing Featherweight unit heater for all types of plants. Special attention will be given to the centrifugal blower which has made great progress during the past year to provide independent control for steam and air for gas producers; also to the air-driven turbine blower for mine ventilation.

Representatives: Alfred E. Seelig, president and general manager; Harry S. Wheller, vice-president; Victor H. Carples, secretary and treasurer; J. M. Hancock, G. W. Gale.

Alan Wood Steel Co., Booth 536
Conshohocken, Pa.

This company will demonstrate its standard AW Diamond and AW Diamondette rolled steel floor plates for all types of steel flooring, runways, cover plates and the like. The plates are especially adapted for locations where there is necessity for raised anti-slip surface without hindrance to free and easy passage.

Representatives: W. S. Haring, general manager of sales; J. R. Jones, engineer; I. M. Smith, sales department.

John Wood Mfg. Co., Booth 407
Conshohocken, Pa.

Wright Manufacturing Co.,
Bridgeport, Conn. Booths 346, 347

Wright-Austin Co., Booth 28
315 W. Woodbridge St., Detroit, Mich.

The company's regular line of steam and oil separators, alarm water columns with trimmings, exhaust heads and steam traps, also pump governors and feed water regulators will be on display. As special features will be found the Airxpel trap, Crescent trycocks and the Kleervu gage glass protector. The last mentioned having a U-shaped glass with enmeshed wire as a safety protection, fastened by garter springs to a heavy wire screen backing which in return is carried on the packing nuts of the gage glass.

Representatives: C. B. Walter, president; Henry Dusenbery, New York manager, in charge of booth.

"X" Laboratories, Booth 256
25 W. 45th St., New York, N. Y.

Yale & Towne Mfg. Co., Booths 425-6
Stamford, Conn.

Yarnall-Waring Co., Booth 24
Chestnut Hill, Philadelphia, Pa.

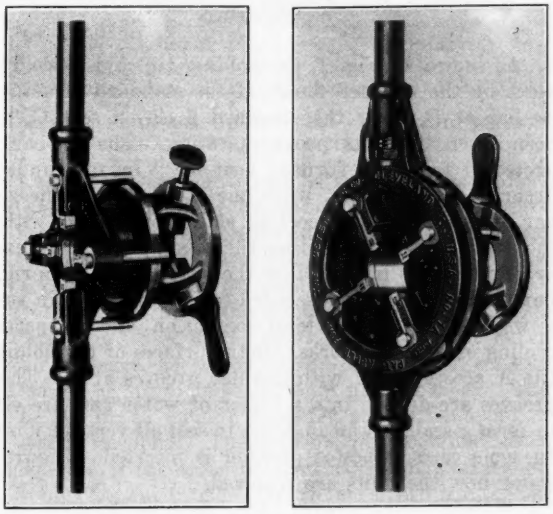
Full line of Yarway Seatless and Double Tightening blow-off valves for all pressures up to 1800 lb., including forged steel valves for boiler blow down and water wall drain service will be exhibited. In addition, will be various types of Yarway floatless Hi-Lo alarm water columns and Sesure inclined water gages, a new development in flat glass gage design being exhibited for the first time. Yarway spray nozzles, hydraulic operating valves and pipe clamps will be featured in the display.

Representatives: L. G. Chase, New York district manager; D. T. Newman, A. L. Aicher.

Power Plant Engineering Developments and News

New Pipe Threader with Universal Guides

DESIGNED TO incorporate among other improved construction features, universal guides that automatically center the pipe, a new threader has just been placed on the market by The Oster Manufacturing Co., Cleveland, Ohio.



TWO VIEWS OF NEW LEADER THREADER WITH UNIVERSAL GUIDES

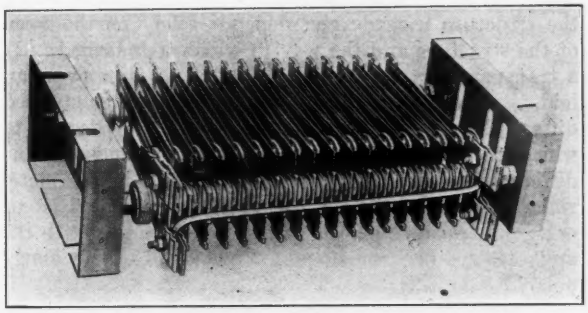
This new tool, called the Leader, is made to thread and cut pipe from 1 in. to 2 in. It is claimed that the universal pipe guides, the different ratchet construction, a floating stud arrangement and fully adjustable dies make the new tool easy to operate and unusually fast in threading and cutting operations. It is also stated that nipples up to 2 in. can be threaded with the same ease and speed of regular pipe.

The Leader is available in either of two types: the No. 1, a plain tool without the ratchet device feature and the No. 1A with the ratchet construction. The ratchet is built directly around the dies where the strain of the pull ordinarily comes, to decrease the effort required to cut the thread. The same construction feature also is intended to permit more freedom of action when working close to a wall or other cramped quarters. On the ratchet type tool, the ratchet can be set for forward or reverse or locked for use as a plain tool by a simple turn of a control wheel.

New Unbreakable Resistor

DUR-RISTOR, A NEW unbreakable resistor with a continuous resistance element is announced by Cutler-Hammer, Inc., of Milwaukee, Wis. Designed to meet the need for a resistor which would give maximum service under the most severe operating conditions, it includes such advantages as being vibration-proof and unbreakable, non-corrodible, light of weight and compact.

The main body of DUR-ristor—the resistance element—consists of two continuous, unbreakable strips. These strips are made of a rust-proof, non-corrodible alloy. They are proportionally ribbed on the sides as



THE DUR-RISTOR

well as on the turning edges. A new method of supporting the strips, combined with the ribbing, permits the strips to expand and contract freely during temperature changes. The entire resistor is made unbreakable and permanent by the elimination of brittle material and by the use of mica for all insulation.

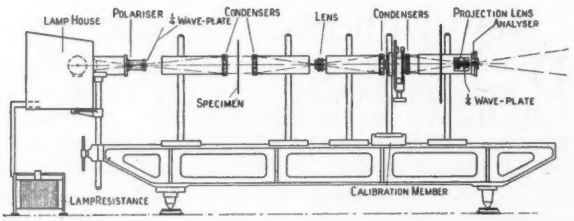
All DUR-ristors, regardless of ampere rating, are of equal size. The thickness of the resistance strip is the only part that varies in size, i. e., according to ampere rating. DUR-ristor is adaptable for any standardization plan for resistor banks and is finding wide application for use with equipment where minimum resistor maintenance is required and where severe operating conditions are encountered.

Coker's Apparatus for Determining Stress Distribution

DETERMINATION of the distribution of stress in structural and machine members is made possible by means of a photo-elastic apparatus devised by Professor Coker and manufactured by Adam Hilger, Ltd., 24 Rochester Place, London, N. W. 1, England. With this apparatus, the distribution, direction and intensity

of the stresses can be completely determined to within plus or minus 2 per cent in any loaded member which can be represented by a plate model stressed in its own plane.

Designed especially for the use of engineers, simple to use, requiring no knowledge of optics, it gives definite and accurate information of the direction and magnitude of stress in any specimen in the form of a plane section, no matter how complicated. Among other things, it has been used for investigations of nuts and bolts, armatures, piston rings, pipes, steam turbine blades, crankshafts and gearing.



COMPLETE PROJECTION AND CALIBRATION AS USED IN COKER APPARATUS

The apparatus, one model of which is shown in the picture, is based mainly upon two principles: (1) the distribution of stress through any loaded isotropic elastic structure is independent of the material of which the structure is made and depends solely on the form of the structure and the way in which it is loaded; (2) a transparent isotropic material, such as glass or celluloid, acquires double refracting properties when stressed differently in different directions and the degree to which these properties are produced depends on the differences between the principal stresses in the material. A model of the structure to be investigated is cut out from transparent celluloid sheet, examined with the apparatus either under plane polarized or circularly polarized light.

Air-Cooled Furnace Wall

By A. L. Nugey

AIR-COOLED FURNACE WALL designed to use standard steel shapes in its construction and to employ a great deal of standard firebrick has recently been placed on the market by Henry Maurer & Son, Maurer, N. J. Object of the design is to reduce the cost of constructing a wall of this type at the same time employing correct and well-adapted principles of ventilated wall design. As shown in the illustrations, no special hangers are used in this construction and each wall unit has been worked out in standard firebrick coursing which is stated to be an exclusive patented feature. This is composed of a single holding tile and 8 standard firebrick per square foot of wall surface. The supporting steel is designed to be entirely flexible and to permit ventilation in both directions. In the design of the service lining, which is made up of the single holding tile and the proper amount of standard firebrick, the combined height of the refractories in each unit is such that it fits in with any firebrick coursing. The joints of the standard firebrick are broken in both directions.

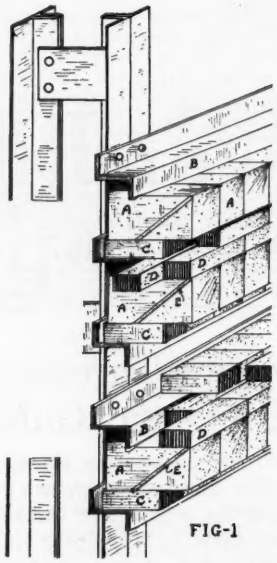


FIG. 1. HOLDING TILE AND FIREBRICK ARE SUPPORTED BY STANDARD ZEE-BAR IN THIS AIR-COOLED WALL CONSTRUCTION

As shown in Fig. 1, the holding tile A is locked in place by the inverted flange of the standard structural zee-bar at B, after the standard firebrick seat C, has been inserted in its proper position. The zee-bar is protected from the furnace heat by 9 in. of standard firebrick set as shown, while the other side of the zee-bar is exposed to the cooling action of the air within the passages. Each holding tile A supports 1½ standard firebrick as indicated by the letter D. The upright flange of the zee-bar is secured to the buckstays in such a way as to allow lateral expansion and to permit cooling of the steel works. Both surfaces of the holding tile A are provided with angular grooves at E. These grooves are dipped into a batter of water and fire clay to form a sealing wad in order to seal all vertical joints. In some cases, asbestos packing is inserted. Figure 2 shows how the units are removed.

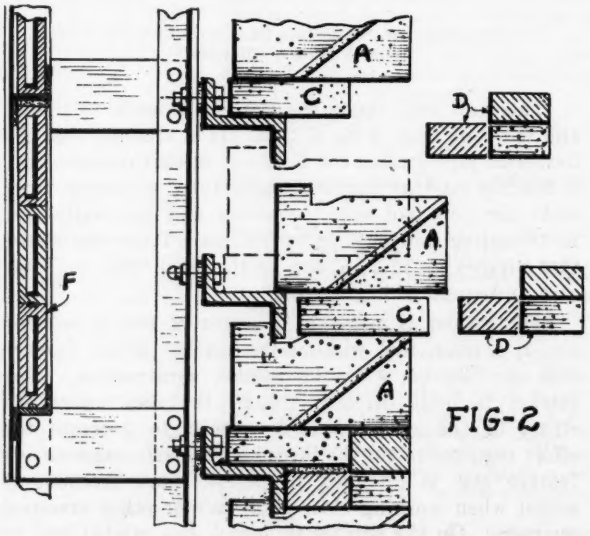
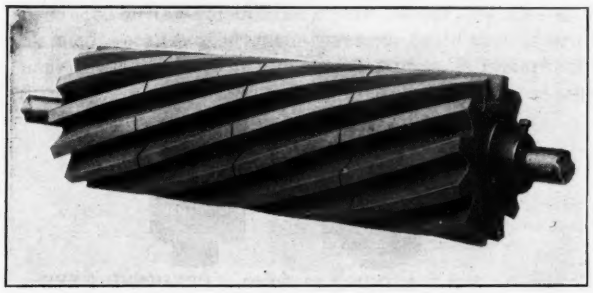


FIG. 2. CROSS SECTION THROUGH WALL SHOWING THE METHOD OF SUPPORT, METHOD OF REMOVING HOLDING TILE AND CONSTRUCTION OF EXTERIOR WALL F

Exterior wall F consists of standard hollow tile or, if desired, of face brick. This wall is supported by outer horizontal structural members. If a combination of insulation and exterior metal casing is chosen, this can be secured to the buckstays and the horizontal members so as to permit the necessary expansion.

Rubber Squeegee Brush for Belt Conveyors

SINCE BELT CONVEYORS were first installed, there has existed in many plants the problem of cleaning the dirt off the return side of the conveyor. Sometimes this material is wet and sticky and often it



RUBBER SQUEEGEE BRUSH FOR CONVEYOR BELTS CONSISTS OF SERIES OF SPIRAL FLUTES

is abrasive. It may cause serious wear to return idlers and, at the same time, accumulation on the floor beneath the belt at the several return idlers near the head end of the conveyor. The latter item in some instances runs into a considerable cost for cleaning up.

To clean such belts, the Robins Conveying Belt Co., 15 Park Row, New York, has recently brought out a rubber squeegee, as shown in the picture. It consists of a series of spiral flutes of high grade rubber. The roll is 7½ in. in outside diameter and is made up in sections 6 in. long. The sections are mounted on a wooden core of the same diameter as that now in use on the Robins bassene brush. The rubber brush is intended to be mounted on the same driving mechanism as is now used on Robins brush cleaners and to displace the present brushes.

This rubber cleaner turns with a peripheral speed of about 1000 ft. per min. The wearing part is about ¾ in. deep; the spiral shape of the flutes, it is claimed, prevents the belt from flopping up and down. The rubber cleaner is located far enough back of the head pulley so that the belt is straightened out from its crowning over the head pulley, thus making the cleaner effective over the entire width of the belt.

One of the advantages claimed for this rubber cleaner brush is that it bears very lightly against the belt, thus preserving not only its own life but that of the belt.

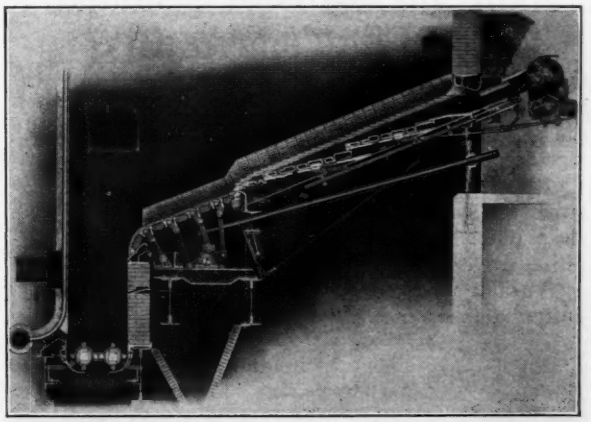
Dynamometer for Turbines and Engines

FOR TESTING steam turbines, steam engines and engines for air craft and automobiles, an absorption dynamometer has been placed on the market by Murray Iron Works Co., Burlington, Iowa. This dynamometer has been built in capacities up to 2000 hp. It consists of from 1 to 10 discs revolving in compartments formed by series of diaphragms. Water admitted from a tank at the top of the brake enters the casing and is thrown to the circumference by centrifugal force to form a ring there. As the discharge valves are closed or the inlet valve opened by manipulation of the discharge inlet valves increasing or decreasing the braking water surface against the discs, the load is increased or decreased.

The casing is cylindrical and is supported on roller bearings to permit rocking and to allow the torque to be recorded on a scale beam. Main bearings of the dynamometer are deep-groove ball bearings for the smaller sizes and self-alining turbine bearings with forced lubrication for the larger sizes. The bearing supports are arranged so that all losses will be recorded as load on the scale beam in order to eliminate corrections. The manufacturer claims that these dynamometers will accurately record loads as low as 3 per cent of the maximum and that in several instances engines have run for several days without load changes exceeding 0.1 per cent of the maximum.

Underfeed Stoker Has Overfeed Rear Section

LATEST Westinghouse multiple retort underfeed stoker for large boilers with heavy loads includes a feature that is an interesting departure from designs usually offered in this class of apparatus. It is an application of an undulating link-grate overfeed section to long underfeed retorts. The principle of this design is that a flat, undulating grate surface of large area,



CROSS-SECTION THROUGH NEW STOKER SHOWING UNDULATING OVERFEED SECTION AT REAR AND METHOD OF DRIVING IT

extending across the entire width of the furnace, moves as a unit at the rear of the stoker. It is designed to receive fuel and refuse from the retorts and, after completing the combustion of this fuel, to discharge the refuse into the clinker grinder pit. It is intended to enable the retorts efficiently to handle larger quantities of fuel than would otherwise be possible.

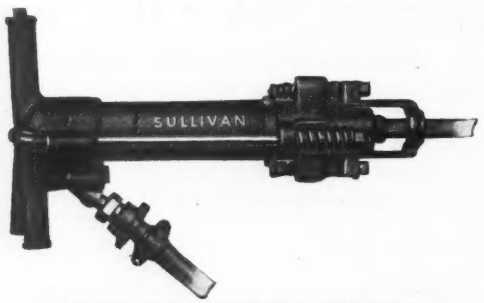
Fuel is burned on the overfeed section, it is stated, in approximately the same combustion cycle as on the underfeed sections. The undulatory motion is designed to combine positive conveying and breaking action and to prevent the formation of large clinkers. This mo-

tion is under separate control. The grate surface proper consists of grate bars fastened in frames hinged together in a chain-like series.

The furnace illustrated is one of the four at the Hudson Avenue Station of the Brooklyn Edison Co. The boilers are 2380 hp. each. Loads exceeding 350,000 lb. per hr. have been successfully handled, it is stated, with no more than ordinary attention to the equipment. This new stoker is made by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Floor and Foundation Breaker

BREAKING old pavement, demolishing old foundations, wrecking walls or buildings and excavation in hard or frozen ground call for sturdy and powerful tools. In the K-2 buster for ordinary work and the K-4 for heavy tasks, the Sullivan Machinery Co. has provided such a tool for operation by compressed air, the K-4 being shown in the illustration. A floating steel piston is driven back and forth in a cylinder bored from a solid steel bar, the bit or drill being held into



SULLIVAN K-4 CONCRETE BREAKER

the chuck by a U-shaped retainer and springs provided to take up vibration. A U-shaped rod with springs on the ends holds handle, cylinder and chuck housing firmly together.

By substitution of a different anvil block front end, either tool may be converted into a hammer for driving sheet piling and they are known as Q-1 or Q-2 sheet piling drivers.

Various forms of bits are provided for pick, chisel, cutter, digging and tamping or blank to be fashioned for special work.

Weight of K-2 is 76 lb. and of K-4 84 lb. or, as equipped for sheeting driving, 104 and 112 lb. respectively.

Lubrication is automatic from a reservoir in the handle and the tools may be used under water for excavation or preparing foundations.

New Conduit Fittings

THREE new types of conduit fittings—a fitting for self-alining pendants, a service entrance fitting and an Adapti type solid fitting—are now being placed on the market by the Adapti Co., 2996 East 72nd St., Cleveland, Ohio.

The self-alining pendant fitting, Fig. 1, designed particularly for use with conduit stem pendants that must be suspended from sloping, rough or uneven ceilings. The base consists of a modified Adaptilet fitting base having a removable side or cover plate for providing easy access to the interior and a lower opening carrying a special design of swivel joint which, although it will not permit the pendant suspended from it to turn or twist the wires, will allow it to adjust itself vertically within a range of 20 deg. on all sides of the center line of the supporting fitting. The fitting is made in three types—left-handed, right-handed and straight-through.

The switch-fitting is of the standard solid type; but, being somewhat narrower than the ordinary pattern of such fittings, it is particularly adapted for use in confined spaces. The interior, however, is large enough to take any of the standard types of switches or two-pin receptacles. For situations where the switch is exposed to dust, fumes or moisture, it may be made weatherproof by the use of the watertight cover, Fig. 2. This

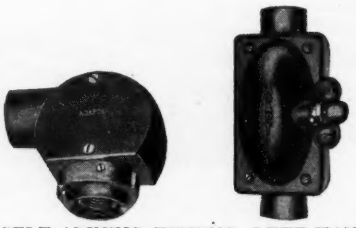


FIG. 1. SELF-ALINING FITTING, LEFT-HAND TYPE
FIG. 2. COMPLETE SWITCH FITTING, WEATHERPROOF TYPE

cover has the entrance point of the switch lever spindle provided with a packing gland; this, in conjunction with the gasket placed between the cover and the base, is to protect the switch mechanism from moisture and corrosion.

Service entrance fitting is designed to make the threading of the wires easier than in the usual type. By removing the two locking screws, the top of the fitting may be entirely removed, exposing the whole interior.

Six-Cylinder Gas Engine Drives New Portable Arc Welder

NEW PORTABLE ELECTRIC arc welding machine announced by the General Electric Co., driven by a 6-cylinder gas engine, is announced to replace the 4-cylinder engine-driven unit previously included in that company's line. Advantages of the 6-cylinder engine, it is claimed, are ease of starting, steadiness of operation and greater capacity. The generator bears the designation WD-300-A.

The new engine is the Buda model HS-6 power unit built especially for industrial service. The cylinder head is a four-cycle, L-type. The S.A.E. horsepower rating is 27.3 and the actual brake horsepower is 39 at 1440 r.p.m. The engine is totally enclosed in a sheet-metal housing. Gasoline consumption, it is stated, averages 2.4 gal. an hour for average welding duty at full normal-rated load.

The welding generator is a ball-bearing, self-excited, single-operator machine rated 300 amp., 1 hour, 50 deg. C. with a current range of 90 to 375 amp. in accordance with N. E. M. A. standards. Included with the set is a current-reducing resistor by means of which welding currents down to 25 amp. may be obtained. The cur-

rent can be adjusted simply by turning the brush-shifting handle. When operating so that the potential at the generator panel, including reactor drop, is 25 v., any value of current can be obtained between 25 and 400 amp.

Differential Chain Hoist

DIFFERENTIAL CHAIN HOIST, stated to possess three new and exclusive features, is announced by Robbins & Myers, Inc., Springfield, Ohio.

Timken thrust bearings are used in the lower hook to permit easy turning of the load and to reducing chain and upper sheave wheel wear caused by chain twisting. The sheaves are of Aremite, an alloyed iron produced in the Robbins & Myers foundry, which, it is claimed, because of a tensile strength twice that of ordinary gray iron and an unusual hardness, is remarkably durable. Aluminum finish is used throughout, chains

NEW CHAIN HOIST WITH TIMKEN BEARINGS AND AREMITE SHEAVES

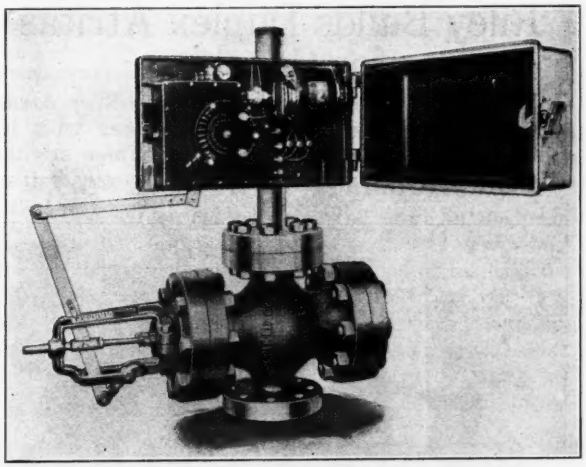
excluded, to provide lasting protection against damage from exposure. The chains are of a special analysis steel, heat treated and electrically welded. This hoist is manufactured in five sizes, with capacities ranging from ¼ to 2 t.

Automatic Flow Control at 1300 Lb. and 600 Deg. F.

ACCURATE MEASUREMENT of flow at high temperatures and high pressures is part of the general problem of high pressures now commanding much attention in the field of steam plant design and in applications such as oil refineries, chemical plants and other industries. Automatic control of flow at these high pressures and temperatures, extremely desirable in many applications, often adds further complications to the manufacture of flow metering equipment destined to cope with high-pressure conditions.

Among installations of this character are several made by the Brown Instrument Co., Philadelphia, Pa. In these installations, the Brown forged steel manometer is used with the Brown electric flow meter, built to operate on the inductance bridge principle, to govern specially-constructed, remote-control valves. One of the latest installations of this character employs the valve shown in the above illustration.

This valve is designed to control automatically the feeding of hot oil to a petroleum cracking still and is built to operate at 1300 lb. pressure and 600 deg. F. temperature. This valve in the still feeder line is in-



REMOTE-CONTROL VALVE DESIGNED FOR GOVERNING FROM AUTOMATIC CONTROL FLOW RECORDER

tended to be controlled by the setting of a Brown automatic control flow recorder located on the instrument panel of the control house, which, it is said, may be any distance from the still.

Bending Reenforcing Rods With Crane and Bucket

COOKSVILLE CO., LTD., of Canada found a novel use for its grab bucket during its recent building program at its plant in Cooksville, Ontario. H. D. Holland, the superintendent, says:

"During our building program, our Link-Belt crawler crane was used constantly in excavating, han-

BENDING REËNFORCING RODS WITH GRAB BUCKET

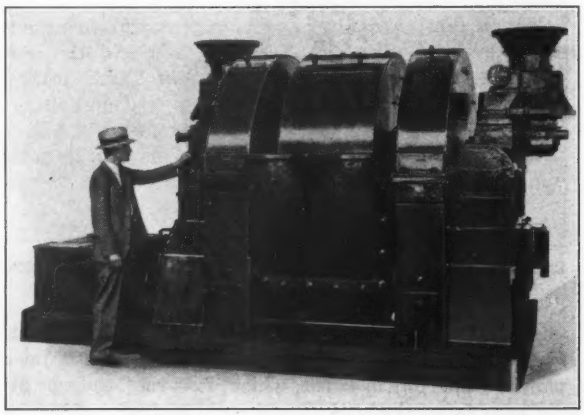
dling aggregates, erecting steel and placing heavy machinery."

"At one time, we were confronted with the problem of bending reënforcing bars for our concrete forms and

it was only natural that we should turn to our crane for a solution. This task was performed by placing several rods through the arms of our Hayward clamshell bucket and then opening the bucket, thereby bending the rods to the exact shape required."

Riley Builds Duplex Atritas for Cahokia

NEWLY DEVELOPED Duplex No. 5 Riley Atrita unit pulverizers, as shown, have been built by Riley Stoker Corp., Worcester, Mass. These are the largest pulverizers manufactured by the corporation,



DUPLEX NO. 5 PULVERIZER HAS CAPACITY OF 15,000 LB. AN HOUR

each pulverizer having a rated capacity of 15,000 lb. of coal per hour.

These machines are practically a combination of two single No. 5 Riley Atrita Unit Pulverizers located on a common shaft, with feeders located at either end and the fans and coal discharge pipes at the center. The housings are of welded construction lined with iron wearing parts. The same peg and fan construction is used as used on single Atrita unit pulverizers. Each feeder is equipped with a four speed transmission for controlling rate of coal feed.

These machines are being shipped to the Cahokia Station of the Union Electric Light & Power Co.

Prime Movers Committee Discusses Condensing Equipment

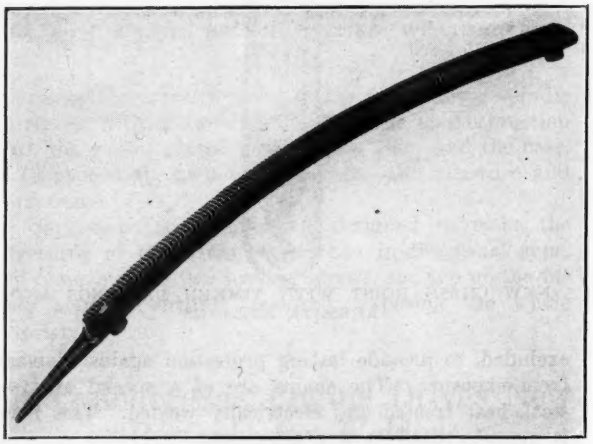
CONDENSING EQUIPMENT, Publication No. 289-111, Serial Report of the Prime Movers Committee, National Electric Light Association, 420 Lexington Ave., New York City, has just been issued. The report states that owing to the lack of sufficient data and to variations in conditions under which condensers operate, it is difficult to make an accurate comparison of the performance of several types of surface condensers. Study of the data received by the committee, after being corrected to a common basis of water velocity and inlet water temperature, indicates that the performance of single-pass condensers is somewhat better than that of the two-pass type. Performance of vertical condensers is appreciably better than horizontal condensers with the same number of passes. Tables are included giving design and performance data for 15 two-pass and 11 single-pass condensers.

Variation of average heat transfer rates with inlet water temperatures is also shown. Excessive condenser leakage resulting from tube vibration has been experienced in some cases. This has been most effectively remedied by the installation of additional tube support sheets and by the use of thicker tubes. Two companies report satisfactory operation with condensers having the tubes rolled into the tube sheet at both ends.

A Flexible File

TO OVERCOME the difficulty of filing down welded joints in large flat or concave surfaces, the Truarc line of files has been increased to include a flexible type which can be adjusted to any desired convexity of filing surface called for in such work.

The complete file, as shown, consists of two parts: the flexible reversible blade which carries teeth on both sides and a bolt hole in each end, and the stiff back to which the blades are bolted. This back may be supplied curved to the required degree or may be readily made



FLEXIBLE FILE FOR WELDED JOINTS ON LARGE FLAT OR CONCAVE SURFACES

by heating and bending one of the regular straight backs used for the regular Truarc backed files.

The file is made by Filecraft, Inc., 3450 Hamilton Ave., Cleveland, Ohio.

TREND OF SOFT COAL PRODUCTION showed practically no change in the week ended September 21, according to the latest report of the Bureau of Mines, Department of Commerce. The total output, including lignite and coal coked at the mines is estimated at 10,867,000 net tons, as compared with 10,863,000 t. in the preceding week. Production during the corresponding week in 1928 was 10,021,000 t. Total production of soft coal during the present calendar year to Sept. 21, approximately 224 working days, amounts to 368,797,000 net tons. Total production of Pennsylvania anthracite during the week ending Sept. 21 is estimated at 1,624,000 net tons, an increase of 135,000 t. or 9.1 per cent over that of the output for the previous week.

Program for 50th A. S. M. E. Meeting, December 2-6

TECHNICAL PROGRAM for the 50th Annual Meeting of the American Society of Mechanical Engineers, December 2 to 6, 1929, has been announced. Sessions will be held as usual in the Engineering Building, 29 West 39th St., New York City.

Of particular interest this year, it is stated, will be the paper to be given on Tuesday evening by L. W. Wallace and J. E. Hannum on Engineers in American Life. The Henry Robinson Towne Lecture, dealing with some phase of the relation between engineering and economics, will be delivered on the same evening by Dr. Alejandro E. Bunge of Buenos Aires, editor of Revista de Economia Argentina. Of the large number of papers to be presented, the following should be of most interest to power plant engineers:

MONDAY, DECEMBER 2

9:30 a. m. Simultaneous Sessions on

HYDRAULIC POWER

Power—Steam or Hydro or Both, Wm. W. Tefft.
Increased Kilowatt Output of Adjustable-Blade Propeller Turbines, C. R. Martin.
Mechanical Vibrations in Penstocks of Hydraulic-Turbine Installations, J. P. Den Hartog (by title).

APPLIED MECHANICS (I)

Factor of Safety and Working Stress, C. Richard Soderberg.
The Mechanics of the Plastic State of Metals, A. Nadai.
2:00 p. m. Simultaneous Sessions.

HYDRAULIC TURBINES

Changing Requirements in Hydraulic Turbine Speed Regulation, Forrest Nagler.
Mechanics of Hydraulic-Turbine Pressure Regulation, A. Pfau.
Progress Report of Hydraulic Division.

APPLIED MECHANICS (II)

Torsional Vibration Dampers, J. P. DenHartog and J. Ormondroyd.
Power Application to Oscillating Axles, A. Madlé.

POWER TEST CODES PUBLIC HEARING

Test Code for Liquid Fuels.

TUESDAY, DECEMBER 3

9:30 a. m. Simultaneous Sessions on

FUELS

Soot Particles in New York City Air, E. E. Free.
Progress Report of Fuels Division.

MATERIALS HANDLING (I)

The Application of Aerial Tramways to Long and Short Hauls, M. P. Morrison.
Progress Report of Materials Handling Division.

APPLIED MECHANICS (III)

The State of Stress in Full Heads of Pressure Vessels, W. M. Coates.
2:00 P. m. Simultaneous Sessions.
8:30 p. m. Report of Nominating Committee.
Introduction of President-Elect.
Engineers in American Life, L. W. Wallace and J. E. Hannum.
Henry Robinson Towne Lecture by Dr. Alejandro E. Bunge of Buenos Aires, Argentina, S. A.
Reception and Dance.

WEDNESDAY, DECEMBER 4

9:30 a. m. Simultaneous Sessions on

INDUSTRIAL POWER

The Pioneer 1800-lb. Pressure Power Plant in America, W. E. S. Dyer

LUBRICATION

(Jointly with Machine Shop Practice Division)
Performance of Oil-Ring Bearings, George B. Karelitz.
The Service Characteristics of Diesel Engine Lubricating Oil, A. E. Flowers and M. A. Dietrich.

STEAM TABLES RESEARCH
POWER TEST CODES PUBLIC HEARING

Test Code for Complete Steam-Electric Power Plants.
6:30 p. m. Annual Dinner, Hotel Astor.

THURSDAY, DECEMBER 5

9:30 a. m. Simultaneous Sessions on

CENTRAL STATION POWER

The Effect of Large Boilers Operated at High Capacities on the Operating Characteristics and Investment Costs of Boiler Plants, F. S. Clark.
Performance of Modern Steam-Generating Units, C. F. Hirshfeld and G. U. Moran.

OIL AND GAS POWER

Progress Report of Oil and Gas Power Division.
Engineering and the Oil Industry, Geo. L. Reid.
Progress Report of Special Research Committee on Diesel Fuel Oil Specifications.
2:00 p. m. Simultaneous Sessions.

GENERAL

Working Stresses for Steel at High Temperature, D. S. Jacobus.

SYMPOSIUM ON THE APPLICATION AND DIMENSIONAL ANALYSIS IN FLUID FLOW

Quantity-Rate Fluid Meters, Ed. S. Smith, Jr.
Similarity: Limitations in its Application to Fluid Flow, J. M. Spitzglass.
The Flow of Fluids Through Orifices in 6-in. Pipe, S. R. Beitler.
Reports of the Sub-Committees of the Fluid Meter Committee.

FRIDAY, DECEMBER 6

9:30 a. m.

BOILER FEEDWATER STUDIES

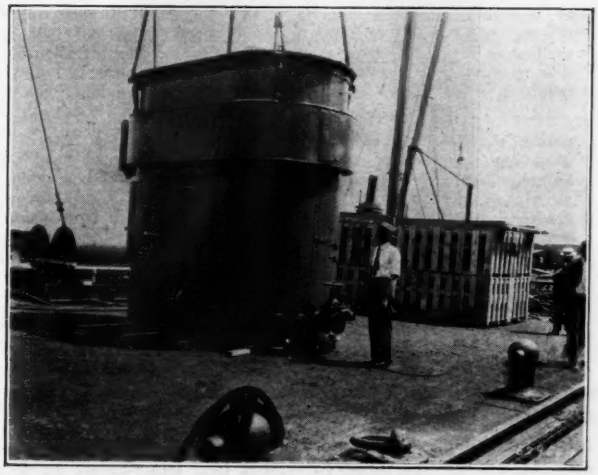
Recent Instances of Embrittlement in Steam Boilers, Frederick G. Straub.
2:00 p. m.

REFRIGERATION
(Jointly with A. S. R. E.)

Thermodynamics of Air Cooling, Barton H. Coffey (contributed by A. S. R. E.).
Engineering Computations for Air and Gases, Sanford A. Moss and C. W. Smith.

New East River Transformers

TRANSFORMERS on the poles and down in the manholes are like midgets compared to the monster transformer shown in the accompanying photograph—all the difference in the world in size but little in the way they work. This is one of the two transformers for installation at the East River station. It is an 18,000-kv-a., 3-phase, 25-cycle transformer. The man standing beside it is J. L. Bogart, assistant superintendent of construction, mechanical construction department, New York Edison Co.



ONE OF THE 18,000-KV-A., 25-CYCLE TRANSFORMERS FOR EAST RIVER

The 25-cycle systems at East River and Gold Street, Brooklyn, where transformers of similar size are installed, will be connected by these two giants. This tie is expected to result in an economy of operation, by making possible the shutting down at intervals of some boilers and generators of the system.

CONSTRUCTION WORK has been started, according to an announcement by A. N. Woodhead, secretary of Mohawk Hudson Power Corp., on a new high-tension transmission line from Oneida to Rome, built as a joint project by the Northern New York Utilities, Inc. and the New York Power & Light Corp., both operating units of the Niagara Hudson Power Corp system. When completed, this line will give Rome an additional source of power supply at 110,000 v. from the Mohawk Hudson transmission system and will supplement the 110,000-v. lines which now supply Rome from the Northern New York system.

Death of John W. Lieb

JOHN WILLIAM LIEB, senior vice-president of The New York Edison Co. and a pioneer in the electric light and power industry, died Friday evening, November 1, at 7:30 o'clock, at his home, 30 Montgomery Circle, New Rochelle, New York, after an illness of several months. Mr. Lieb, senior vice-president of The New York Edison Co. and associate of Thomas A. Edison in designing and installing equipment for Pearl St. Station, in New York City, the first central station in the world, which was put in operation September 4, 1882, gave the whole of his business life to the electrical industry.

Born in Newark, New Jersey, February 12, 1860, he attended the Newark Academy and Stevens High School, Hoboken, N. J., and was graduated from the Stevens Institute of Technology, Hoboken, N. J., in

JOHN W. LIEB

1880 with the degree of mechanical engineer. That same year he was employed by the Brush Electric Co., Cleveland, Ohio, as draftsman. The following year he returned to New York City and was employed as draftsman by the Edison Electric Light Co., the parent light company which was formed in 1878 to finance Edison's experiments and inventions for his proposed system of lighting.

Mr. Lieb assisted in making the plans for the "Jumbo" dynamos and in the design of the generator switches, regulating apparatus and electrical equipment for the Pearl St. Station. In 1881 he was transferred to the Experimental and Testing Department at the Edison Machine Works, Goerck St., New York, and was engaged in researches and investigations on electric meters, regulators and electrical apparatus under the personal direction of Mr. Edison. In 1882, he was assigned to the Pearl St. Station in general charge of the planning and installation of the electrical equipment. On September 4, the date the station was put into regular operation under the auspices of the Edison Electric Illuminating Co. of New York, he was appointed its first electrician in charge of the electrical equipment.

In November, 1882, he was selected by Mr. Edison to go to Milan, Italy, to direct the installation of the Milan Edison Station. On the organization of the Societa Generale Italiana di Elettricita, Sistema Edison, he was appointed its chief electrician, then chief engineer and finally technical manager and director of stations.

In 1893, there was put into regular service, under Mr. Lieb's direction, in Milan one of the earliest trolley systems in Italy. For this pioneer work he was decorated by the Italian Government as Knight Commander of the Royal Order of the Crown of Italy and later promoted to Grand Officer. In 1925, he was made "Ufficiale" of the Order of S. S. Maurizio e Lazzaro, and in 1928 was honored by the French Government, receiving the decoration of Officer of the Legion of Honor.

In 1894, Mr. Lieb returned to America as assistant to the executive of the Edison Electric Illuminating Co. of New York, and later became third vice-president and general manager, serving in this capacity until the company's reorganization as The New York Edison Co. in 1901. As vice-president and general manager of the company, Mr. Lieb had general charge of the installation and operation of the Power Plants and Distributing System in New York and was the executive in charge of the company's technical operations. He was senior vice-president and a director of The New York Edison Co., president and chairman of the Board of Electrical Testing Laboratories, vice-president and member of the board of directors of various subsidiary organizations.

Mr. Lieb was a past president and fellow of the American Institute of Electrical Engineers; past president, Association of Edison Illuminating Companies, National Electric Light Association, the New York Electrical Society and the Edison Pioneers; past vice-president of the American Society of Mechanical Engineers and member of many other scientific bodies. He had been, for many years past, the chairman of the Lamp Committee of the Association of Edison Illuminating Companies, and during the war was chairman of the National Committee on Gas and Electric Service, of the Committee on Public Utilities of the United States Chamber of Commerce, and of other industrial bodies.

On February 4, 1924, Mr. Lieb was awarded the Edison Medal by the American Institute of Electrical Engineers for his work in connection with the development and operation of electric central stations for illumination and power. In 1921, he received the honorary degree of Doctor of Engineering from Stevens Institute of Technology.

News Notes

COMBUSTION ENGINEERING CORP. announces the opening of a district office at Room 606, 1411 Fourth Ave., Seattle, Wash., with George M. Bechtel, recently of the corporation's Los Angeles office, as branch manager.

CHAIN BELT CO., Milwaukee, Wis., has opened a New England district office in Boston at 950 Park Square Building. J. K. Merwin is district manager.

KITTS MANUFACTURING CO. of Oswego, N. Y., announces the appointment of the Ladd Equipment Co., Farmers Bank Building, Pittsburgh, Pa., as exclusive representative in Western Pennsylvania, Eastern Ohio and West Virginia. Robert E. Chew, vice-president, and James Burke, treasurer, formerly associated with the Ladd Boiler Corp., will direct sales.

FORD MOTOR CO. has ordered one 600-hp. and one 300-hp. oil-electric locomotive from the Ingersoll-Rand Co. for the River Rouge Plant. These locomotives will be furnished with General Electric equipment and will be built at their Erie works.

GENERAL REFRACTORIES CO., Philadelphia, Pa., has appointed the Desch Supply & Equipment Co., 16 South Frederick St., Baltimore, Md., as its representative in the state of Maryland.

THAT AMERICAN ENGINEERS are capable of producing Diesel engines which are the equal of any in the world is evidenced by the fact that Carels Freres of Ghent recently have completed their first engine under license from the Worthington Pump & Machinery Corp. The engine, a four-cylinder, 2-cycle, double-acting unit developing 4000 br.hp. at 128 r.p.m., has cylinders 28 in. in diameter and a stroke of 40 in. It is similar to the engines that Worthington has furnished the Shipping Board and is to drive a large alternator in South America. A second engine of this design is now being built by Carels Freres for service in the same power station.

WILLIAM E. WOOD, formerly president of Virginia Electric & Power Co., Richmond, Va., a subsidiary of Engineers Public Service Co., has been elected vice-president in charge of operations of the latter company with headquarters in New York City. Mr. Wood has also been elected chairman of the board of directors of the Virginia Electric & Power Co. J. Frank McLaughlin, since the first of the year district manager of the southwestern district properties of Stone & Webster, Inc., located in Texas, Louisiana and New Mexico, succeeds Mr. Wood as president of the Virginia Electric & Power Co. Previous to his appointment to the district office, Mr. McLaughlin was operating vice-president of the Virginia company.

VOLUNTARY PETITION in bankruptcy was filed on November 1 against the W. B. Foshay Co., holder of public utility, industrial, banking and real estate properties. Collapse of the parent company involved many subsidiary organizations. In the receivership action were also named the Public Utilities Consolidated Corp., the utility operating subsidiary and the W. B. Foshay Building Corp. Joseph Chapman, Minneapolis, banker, was named receiver. Although assets of the Public Utilities Consolidated Corp. are listed at $20,000,000, it was said they might be higher. Liabilities of $12,000,000 are charged against the Foshay interests by the petitions, which state that Mr. Foshay finds himself with a large amount of stocks, bonds and notes that he finds difficulty in selling and faces the necessity of paying large amount of the obligations with no ready money to do so.

AMERICAN LOCOMOTIVE Co. announces that it has acquired control of the McIntosh & Seymour Corp. of Auburn, N. Y. The corporation will continue to operate under the present management but as a subsidiary of the American Locomotive Co.

KUHLMAN ELECTRIC Co., Bay City, Mich., announces the appointment of Frank C. Fassett, 15 East Jackson St., Phoenix, Arizona, as its representative in that territory.

ANNOUNCEMENT is made that Harry H. Hunt has been elected chairman of the board of directors of Stone & Webster Service Corp. and that George H. Clifford succeeds Mr. Hunt as president. Mr. Clifford has been with the Stone & Webster organization 28 yr., having initially been employed by the Northern Texas Traction Co., at Fort Worth, Texas, in 1901.

PAUL F. SWASEY has recently joined Stone & Webster Engineering Corp. as engineer in the structural division at the Boston office, coming from J. R. Worcester & Co., with which firm he has been affiliated for the past three years on designing and soliciting work.

MARY O. SOROKA, M. I. T. 1926, has been employed by Stone & Webster Engineering Corp. as engineer in the hydraulic division at Boston. Miss Soroka has worked on structural steel design with H. G. Balcom, Spencer, White & Prentis and Purdy and Henderson Co., all of New York City, and for several months during the early part of 1929 was engaged as research assistant in hydraulic and sanitary engineering at the University of Wisconsin.

WAGNER ELECTRIC CORP. announces that its Milwaukee sales office and service station has been moved from 501 Broadway to 525-27 Broadway. The St. Louis sales office has been removed from 505 Shell Building to 909-9 Plaza Olive Building.

VIRGINIA PUBLIC SERVICE Co., Charlottesville, Va., has concluded negotiations for the purchase of site for a proposed hydroelectric generating plant at Greaver's Mill on the Jackson River in the vicinity of Covington, Va., and it is understood that plans will be perfected for the unit at an early date. The station will have an ultimate output of more than 100,000 hp. and is reported to cost close to $2,000,000, with transmission lines for connection with present system. A. W. Higgins is president.

WORK OF THE experimental station at the University of Illinois, Champaign, Ill., in coöperation with the Research Commission of Public Utilities will be reviewed and discussed, Nov. 8 and 9, at a meeting of the commission at the university. Prof. H. F. Moore of the department of theoretical and applied mechanics department of the university is in charge of arrangements for the gathering, which will view and hear reports upon progress in a score of utilities fields. W. L. Abbott, Chicago, is head of the commission.

MILWAUKEE ELECTRIC RAILWAY & LIGHT Co., Milwaukee, Wis., a subsidiary of the North American Co., Cleveland, Ohio, has plans in progress for the construction of a new generating plant at Port Washington on the shore of Lake Michigan, where excellent harbor facilities are available for coal and water supply. The new plant will be equipped for an initial capacity of about 75,000 kw., with facilities for additional equipment to increase this output to 300,000 kw. at a later date. A steel power transmission system will be built to connect with present lines of the company, primarily for service in the north side industrial district of Milwaukee. The plant is estimated to cost about $7,500,000 with ultimate development to approximate $20,000,000. In connection with the new station, the company proposes to purchase an existing municipal distributing system at Port Washington and to furnish light and power for residential and industrial service. Active construction is scheduled to begin early in the spring.

PENNSYLVANIA WATER & POWER Co., Holtwood, Pa., with headquarters at Baltimore, Md., has plans maturing for the construction of a hydroelectric power plant at Safe Harbor, about 8 mi. upstream on the Susquehanna River from present hydroelectric station at Holtwood. A subsidiary organization to be known as the Safe Harbor Water Power Corporation has been formed to carry out the development, which will consist of a power dam to provide for a storage of 3,000,000,000 cu. ft. of water and generating station with initial capacity of 230,000 hp., to be increased later to about 500,000 hp. The project will include an extensive transmission system to connect with present lines of the company and to points in Baltimore, Md., where power will be furnished to the Consolidated Gas, Electric Light & Power Co., an affiliated interest. The entire development is reported to cost close to $25,000,000. It is understood that work is scheduled to begin early in the spring and that major construction will be handled by the Arundel Corporation, Baltimore. The present hydroelectric power plant of the company at Holtwood, as well as standby steam-operated generating station at same location, will be continued in service as heretofore. J. E. Aldred is president of the three affiliated power companies noted.

STEAM & COMBUSTION Co., 205 West Wacker Drive, Chicago, has been incorporated for the production and sale of gas fired boilers and kindred lines. The company is owned and operated by the G. W. Dulany Trust, Chicago. G. W. Dulany, Jr. is chairman of the Board, C. B. Page is president, Wm. E. Eberhart is vice-president and treasurer and Jas. E. Moore is secretary and assistant treasurer. Directors include all of the officers and G. W. Dulany III, L. A. McDowell and W. R. Zitzewitz.

CUTLER-HAMMER, INC. states that its St. Louis district sales office has moved from 611 Olive Street to 1914 Washington Avenue, St. Louis, Mo.

DR. ROBERT A. MILLIKAN and Dr. Arthur H. Compton, professor of physics at the University of Chicago, are members of the editorial and advisory committee of the newly formed Scientific Book Club. This newly formed enterprise will furnish to its members each month the most significant and worthwhile new book in the scientific field as selected by an editorial committee consisting of Dr. Kirtley F. Mather, chairman, Dr. Edwin G. Conklin, Dr. Harlan T. Stetson, Dr. Arthur H. Compton and Dr. Edward L. Thorndike. Associated with the editorial committee is an advisory committee composed of eleven eminent scientists. The editorial office of the Scientific Book Club is at 22 Oxford St., Cambridge, Mass., and the business office at 80 Lafayette St., New York City.

MCKIERNAN-TERRY DRILL Co., 15 Park Row, New York, on November 1 changed its corporate name to McKiernan-Terry Corp., and acquired ownership of The National Hoisting Engine Co., Harrison, New Jersey and Steele & Condict, Inc., Jersey City, New Jersey. The National Hoisting Engine Co. and Steele & Condict, Inc., will preserve their identity to the extent that they will operate and be known as divisions of the McKiernan-Terry Corp. of which Arthur W. Buttenheim is president.

FORSBERG MANUFACTURING Co. has recently placed on the market a new utility hack saw, the Champion No. 125, adjustable to take any length blade. When equipped with the new Forsberg broken blade attachment, this hack saw is designed to accommodate any broken blade part.

HILL-CURTIS Co. of Kalamazoo, Mich., announces that its name has been changed to Hammond Machinery Builders, but that the change in name signifies no change in either organization or policies. W. E. Hammond is president.

E. W. FOWLER, manager of the northern Illinois properties of the Illinois Power & Light Corp., has been made general manager of the central Illinois holdings of that company with headquarters in Decatur. He succeeds the late M. L. Harry. Mr. Fowler has been identified with downstate utilities activities since 1906 when he joined the McKinley interests, whose holdings later became the

present Illinois Power properties. He was a close associate with the late Senator William B. McKinley and advanced to assistant vice-president in the company, continuing when the Illinois Power and Light was formed and took over the McKinley interests.

DAMPNEY CO. OF AMERICA, Boston, Mass., announces the opening of a direct factory branch office in the Bourse Building, Philadelphia. C. J. Hunter, who has represented the company for the past three years, will continue as branch manager.

COMBUSTION ENGINEERING CORP., American subsidiary of International Combustion Engineering Corp., New York, announces the receipt of award for the complete fuel burning and pulverizing equipment for six 3256-hp. boilers to be installed in the Ashtabula plant of the Cleveland Electric Illuminating Co. The 195,360 sq. ft. of boiler heating surface will be fired by Lopulco pulverized fuel systems and approximately 2,700,000 lb. of steam per hour will be generated.

THE DOMINION COAL CO., an interest of the Dominion Steel Corporation, Montreal, Que., both controlled by the British Empire Steel Corporation, Montreal, has awarded a contract to the United Engineers & Constructors, Ltd., Montreal, Canadian subsidiary of the United Engineers & Constructors, Inc., Philadelphia, Pa., has approved plans for the construction of a steam-operated electric generating plant on the tidewater at Glace Bay, Nova Scotia. The initial installation will consist of a 7500 kva. steam turbo-generator unit with boilers and auxiliary equipment. The boiler units will operate at 450 lbs. steam pressure and will utilize pulverized coal as fuel. The new plant will be of distinctly modern type and is reported to cost in excess of $400,000. Work will be placed under way at once.

ACCEPTANCES to simplified practice recommendations, now in effect, amount to 22,742, of which number 21,488 are from individuals and 1254 from trade associations, according to an announcement just made by Ray M. Hudson, assistant director of the National Bureau of Standards, Department of Commerce. His announcement is based on a review of the activities of the Commercial Standardization Group of the Bureau of which he is in charge, for the 3rd quarter of this year. The number of acceptances to commercial standards now totals 1758. During the period (July 1 to September 30) for which the review is made, there was a gain of 753 acceptances to simplified practice recommendations and 322 acceptances to commercial standards.

NEW ORDERS for 1909 steel boilers were placed in September, as reported to the Department of Commerce by 80 manufacturers, comprising most of the leading firms in the industry, as compared with 1859 boilers in August and 1749 in September, 1928.

Books and Catalogs

STEAM AND GAS ENGINEERING, by Thomas E. Butterfield. D. Van Nostrand Co., Inc., New York, 1929; 481 pages, 335 illustrations, 31 tables; 6 by 9 in.; cloth binding; price, $4.50.

Planned as an introductory text for students and engineers, this book is based on a knowledge of physics, chemistry, thermodynamics and of mathematics including higher algebra, trigonometry and calculus. It discusses fully the theory and principles of the utilization of heat energy by means of boilers, steam engines and turbines and internal combustion engines but relates these to actual machines by means of descriptions, illustrations and practical problems showing application of principles to the machines described. At the end of each chapter is a quite complete reference list of books and articles in technical journals on the subject of the chapter, also problems for applying the subject matter to every-day practice.

While higher mathematics is used to some extent in derivation of formulas and discussion of principles, the results reached are given in plain language and as simple equations as possible.

Starting with properties of fuels, the principles of correct combustion and their application in furnaces using grates, stokers and pulverized fuel burners are covered. Relations of heat and mechanical energy, properties of steam and the operation of the boiler and accessory equipment are discussed. Next laws of gases and vapors, steam and gas cycles and the operation of steam and internal combustion engines and of turbines are treated covering details of fluid action, of regulation and the construction of parts.

The author has followed well his plan of alternating discussion of theory and practice to clarify their relation and has used for illustration good examples of modern equipment. His aim has been to make the subject easy to acquire, to assimilate and to retain. He has apparently succeeded and the book should be found useful by engineering students and teachers, also for study and reference by engineers dealing with problems of heat utilization.

ENGLISH AND SCIENCE, by Philip B. McDonald, Associate Professor of English, College of Engineering, New York University; 192 pages, 6 by 8½ in.; cloth. D. Van Nostrand Co., Inc., New York; price, $2.00.

What are the actual problems of writing that the engineer has to solve in the course of his professional work? Two principal types of writing present themselves to him, says Professor McDonald. One is the report, written for submission to superiors or clients; another variation of the report is the article for publication or the paper for delivery before an audience. The other type is the business letter. If the engineer can learn to write these two types acceptably, he should be able to meet all the important situations that arise.

Shall the engineer write his report in the formal third person style or in the informal first person? What is the value of outlining an article before writing it for publication? What must the engineer consider in beginning his report or paper? How can he get away from the awful dullness and stiltedness of the average business letter and write one that will be alive, productive of attention, full of his own personality and at the same time business-like and absolutely correct in its engineering and legal phases?

Professor McDonald discusses such points as these with clarity and enthusiasm and with a freedom from dogmatism that is refreshing. While he does not gloss over the importance of correct diction, he takes the sane attitude towards it that every professional or amateur writer must adopt. "Emphasis, in a study of English composition," he says, "should be less on minutiae of grammatical technicalities and more on suggestions for achieving naturalness, clearness and conciseness." In other words, the engineer should avoid the extreme of school-marmism and of colloquialism.

In his comments on presentation of papers by speakers before technical societies, the author might profitably have given definite instructions as to how certain things can be done by a speaker instead of simply saying that they should be done for, in most cases, it is ignorance of just how to overcome his faults that handicaps the poor speaker, rather than failure to realize that he has faults. But the author does bring out the really important point that a speech or a paper is something intended to be heard by his audience.

These and other allied problems of engineering writing—precision, conciseness, use of words and so on—are discussed and the book concludes with two fascinating chapters on cultural reading and readings about inventions.

We feel that Professor McDonald has done a mighty good job that needed to be done. Some parts of his book could well be amplified with more specific details but many other parts could scarcely be bettered. Any engineer who wants to improve the reports and letters he writes during his every-day work will be stimulated by Professor McDonald's suggestions.

JOHNS-MANVILLE SERVICE to the Electrical Industry is the title of a 20-page bulletin just issued by Johns-Manville Corp., 292 Madison Ave., New York City. This publication describes asbestos ebony, electrobestos and transite as made by the company for various industrial purposes such as switchboard construction, insulation of electrical equipment and fabrication of equipment parts.

YOUNGSTOWN PIPE is described in a recent 62-page bulletin issued by The Youngstown Sheet & Tube Co., Youngstown, Ohio.

H-P-M VALVES for high-pressure hydraulic systems are described in Catalog 111 A1, a 60-page illustrated bulletin issued by The Hydraulic Press Manufacturing Co., Mt. Gilead, Ohio.

FIREBOND, a cement designed to bond the walls all the way through, is described in a 12-page bulletin issued by Harbison-Walker Refractories Co., Pittsburgh, Pa. This material is a high temperature cement and the bulletin describes its uses and gives tables for calculating the quantities of brick required for arches of different spans.

GURNEY BALL BEARING MANUAL, an illustrated 203-page encyclopedia of ball bearing information in handbook form, has recently been issued by Gurney Ball Bearing Co., Jamestown, N. Y. It describes in detail the 14 types of ball bearings manufactured by the company, contains a chapter of engineering data to aid in selection of ball bearings and is provided with a step index for convenience in finding information.

TO BE INSERTED in the "Data Sheets for Thermolier" loose leaf binder, Grinnell Co., Inc., 260 West Exchange St., Providence, R. I., has just issued 16 revised and new pages to bring the data up to date. Revised pages are 1-A, 2-D, 3-A, 3-B, 4-A, 4-B, 4-C, 5-A, 6-A, and 6-B. New pages to be inserted in the binder are 1-B, 1-C, 4-D, 4-E, 4-F and 4-G.

INDUSTRIAL REGULATORS are described in detail in a loose-leaf catalog now being issued by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. This catalog comprises a group of bulletins classified under three headings: I, Industrial Motor Valves; II, Temperature, Pressure and Combustion Controllers; III, Automatic Control for Unit Heaters.

NICHOLSON WELDED STEEL FLOAT, a heat-treated, nickel-plated non-collapsible float for steam traps, water columns, float valves and so on, is described in bulletin No. 929 by W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.

ILLINOIS CHAIN GRATE STOKERS with dampered air control are described and illustrated in a 16-page bulletin issued by Illinois Stoker Co., Alton, Ill. Type G stokers for forced draft and type C for natural draft, are described and the bulletin contains many photographs of installations of these units.

STRAINERS are described in a recent 24-page publication, bulletin A-4, issued by Elliott Co., Jeannette, Pa. This describes various types of twin strainers, motor-operated strainers, twin oil strainers, intake strainers and others. Tables and drawings showing dimensions are presented, with illustrations of installations. In Bulletin L-2 the company describes Elliott 3550-r.p.m. induction motors designed for high efficiency with high power factor, leakless bearings and good ventilation. In Bulletin L-3, Elliott synchronous motors for compressor drive are describe. These motors are designed with motor characteristics and flywheel effect properly related and for ample starting torque without undue starting current.

FARVAL SYSTEM of centralized lubrication is described in detail in a 16-page illustrated bulletin issued by Lubrication Devices, Inc., Battle Creek, Mich.

AUTOMATIC COMBUSTION CONTROL is discussed in a new bulletin, No. 181, now being distributed by the Bailey Meter Co., Cleveland, Ohio. Features of the Bailey control, such as automatic readjustment of fuel-air ratio by the steam-flow-air-flow relation of the Bailey boiler meter; maintenance of desired excess air at any rating; and master pressure contractor to anticipate changes in steam pressure and send out impulses to provide for the new conditions before they actually appear, are described by this bulletin. Details of the equipment are given including details of interlocks to prevent deficiency of air at high or low ratings and other limiting devices. Illustrated descriptions of automatic control in several large central stations are also included.

BUCKEYE DIESEL ENGINES are described in a 24-page bulletin No. 505, issued by the Buckeye Machine Co., Lima, Ohio. Details of engine parts are described and illustrated and the bulletin discusses seven Buckeye features of: air turbulence to produce complete combustion, full lubrication throughout, cylinder heads removed without disturbing manifolds or piping, inbuilt air, fuel and lubricating oil filters and full enclosure.

AMERICAN SOCIETY for Testing Materials, Philadelphia, Pa., has recently published a 200-page book containing all the methods of testing insulating material developed by the society as reported by its committee D-9 on Electrical Insulating Materials, together with the Annual Report of the Committee presented to the Society at the June meeting. The testing equipment is completely described and well illustrated and the methods of testing given in detail. The pamphlet is available at a price of $1.00 for single copies.

PURIFICATION OF STEAM to protect superheaters, turbines and other apparatus from water and solids carried with the steam is discussed in bulletin 684 by the Cochrane Corp., Philadelphia, Pa. The bulletin discusses the benefits of clean steam, requirements to be met by steam purifiers and describes the Cochrane Steam Purifier with results of numerous tests. The publication contains a brief discussion of steam calorimetry with charts to save calculation.

FUEL BURNING and Steam Generating Equipment covering pulverized coal systems, air preheaters, water-cooled furnaces, stokers and boilers are described and illustrated in general condensed catalog GC5 issued by Combustion Engineering Corp., 200 Madison Ave., New York, N. Y.

REPORT OF THE Oxy-Acetylene Committee to the International Acetylene Association in an 86-p. booklet covering progress in welding and cutting apparatus, generators, training of welders and methods for control of the work, application of welding in various fields including power plants and heating systems. The report is published by the International Acetylene Assn., New York, N. Y.

GREEN CHAIN GRATE stoker (natural draft) is described in a new catalog issued by Combustion Engineering Corp. Among the interesting features of this catalog are the table on page 24 which shows three typical evaporative tests, and drawings on pages 21, 22 and 23 which show applications of this stoker to various types of boilers. Copies are available and will be sent to those interested upon request.

TWO BULLETINS, 8½ by 11 in., in two colors, just issued by the Sullivan Machinery Co., describe improved Compressed Air Concrete Breakers and Clay Spaders. Bulletin 87-A describes the M-1, 1929 model Clay Spader, with numerous pictures of spaders operating under different conditions, for excavation both above ground and in tunnel excavations.

Bulletin 87-B describes Sullivan K-2 Buster, K-4 heavy duty Buster and adaptation for sheet pile driving by use of a special head. When equipped with this head, the tool is known as the Q-1 or Q-2 Pile Driver and gives additional utility at small expense. Field photographs show numerous applications of the tools.

PREVENTION of damage by termites, small, blackish, white-winged ants, often seen flying about in the spring and fall, is discussed in a bulletin issued by the U. S. Department of Agriculture, leaflet 31-I. The termites attack wood which has contact with the ground, working on the interior of the wood and may do extensive damage unless checked. The leaflet may be had free on application to the Department of Agriculture, Washington, D. C.

COAL WASHING investigations have been under way for some time by the Bureau of Mines, Department of Commerce, Washington, D. C., and the results of these investigations are now available in bulletin 300 by H. F. Yancey and Thomas Fraser. Methods of testing washability of coal are given, construction of a satisfactory washing plant and the advantages from washing various sizes of coals. Copies of the bulletin may be had from the Superintendent of Documents, Government Printing Office, Washington, D. C., price 50 cents.

BOX HEADER boiler construction as developed by Combustion Engineering Corp'n, 200 Madison Ave., New York City, in which headers are constructed of two sheets joined by a single riveted lap seam, is described in a folder recently issued. Copies may be had by application to the corporation at the above address.

TRANSMISSIVE POWER AND STRETCH OF BELTING, by C. A. Norman, professor of machine design, and G. N. Moffat, instructor in mechanical engineering, The Ohio State University, has recently been issued as Bulletin No. 41 by The Engineering Experiment Station, The Ohio State University, Columbus, Ohio. This gives the results of an investigation conducted by the authors on various types of belts at various speeds. Discussion of pull efficiency, weight and stretch of belts and permanent stretch figures resulting from the experiment are given by text and tabulation.

WALWORTH SIGMA STEEL VALVES and fittings for working pressures up to 1200 lb. and temperatures up to 1000 deg. F. are described in detail in an 86-page book issued by Walworth Co., Boston, Mass. Dimension tables and price tables are included with illustrations of the valves and data on flanges and bolts.

BRISTOL'S RECORDING PSYCHROMETERS of the self-contained and distance recording types with their accessories and charts are described in detail in catalog No. 2100 just issued by the Bristol Co., Waterbury, Conn.

FIRE BRICK, fire clay shapes, mouldable furnace lining and high-temperature cements are described and their applications illustrated in a 60-page catalog, 141-K just issued by the Denver Fire Clay Co., Denver, Colo. The catalog contains cuts and tables on furnace construction. The company is also issuing a new bulletin, 142-K describing flat suspended arches, monolithic furnace wall construction and suspended arches for horizontal return tubular boilers.

BACHARACH ENGINE INDICATOR, Maihak Type, for speeds up to 2200 r.p.m. and pressures up to 5000 lb. are described in Bulletin 1262 by Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa. Bulletin 1263 describes the indicator for use with Diesel, gas and steam engines, ammonia compressors and pumps, while Bulletin 1264 describes the indicator with power integrator.

CAST STEEL and iron gate valves for steam, gas, oil and water are described in bulletin 100 by Pittsburgh Valve, Foundry and Construction Co., Pittsburgh, Pa. These include valves for working pressures up to 1200 lb. per sq. in.

MOTORS, generators, compressors and accessories are described in bulletin No. 36 by Rockford Power Machinery Co., 620-626 Sixth St., Rockford, Ill.

UNION BENT TUBE BOILERS of the new "N" type are described in an attractively illustrated 24-page bulletin issued by Union Iron Works, Erie, Pa. The name of the type is taken from the design of the boiler, which is shaped like the letter N. Instead of a front brick wall, an integral radiant heat element replaces the front arch and front wall construction, designed to expose nearly double the effective boiler heating surface to direct radiant heat. The boilers are made in three and four drum types and the catalog illustrates standard settings, as well as describing shop facilities for the manufacture of the boiler.

Power Plant Construction News

Idaho, Wallace—The Little Pittsburgh Mining Co., Wallace, plans installation of electric power equipment in proposed new flotation mill at mining properties, entire project to cost more than $350,000. Herman J. Rossi, Wallace, is in charge.

Ill., Chicago—The Merit Hardware Mfg. Co., 2125 West Rice Street, plans installation of electric power equipment in projected three-story plant on Cicero Avenue, entire development estimated to cost close to $300,000.

Ind., Jasper—The Hoosier Desk Co., Jasper, has approved plans for a one-story boiler plant, 48x60 ft., in connection with a new factory unit, entire project to cost about $90,000. Thole & Legeman, American Trust Building, Evansville, Ind., are architects.

Kan., Wichita—The Kansas Gas & Electric Co., Market Street, has plans under way for a general mechanical and electrical service building, with equipment, storage and repair facilities on East Central Avenue, entire project to cost more than $500,000.

Mass., Boston—The Rubel Ice Co., 200 Geneva Avenue, has filed plans for construction of an ice-manufacturing plant at site noted, to cost about $100,000, with equipment.

Md., Baltimore—The Bethlehem Steel Co., South Bethlehem, Pa., plans installation of electric power equipment, including heavy mill motors, controls, etc., in connection with an expansion and improvement program at its steel mills at Sparrows Point, Baltimore, entire project to cost about $25,000,000.

Md., Baltimore—The Guilford Folding Box Co., Eager Street, plans installation of electric power equipment in new plant on the Philadelphia Road, entire project to cost $175,000.

Md., Edgewood Arsenal—The Chemical Warfare Service, Edgewood Arsenal, will receive bids until Nov. 11, for two centrifugal pumping units, as per Circular 65.

Mich., Grand Rapids—The Pere Marquette Railroad Co., Detroit, plans installation of electric power equipment in connection with proposed rebuilding of car repair shops at its Wyoming yards, Grand Rapids, destroyed by fire Oct. 18, with loss reported at close to $100,000.

Mich., Marysville—Gar Wood, Inc., Algonac, Mich., will install electric power equipment in new boat-building and repair plant at Marysville, entire project to cost upward of $100,000.

Minn., St. Paul—The R. S. Cobb Co., 2 East Third Street, plans construction of one-story power plant at Groves and John Streets, in connection with new produce building, entire project to cost $140,000. Campher & Puetow, 1380 Blair Street, St. Paul, are architects.

Miss., McComb—The Southern United Ice Co., will make extensions and improvements in local ice-manufacturing and cold storage plant with installation of additional equipment, reported to cost more than $50,000, with equipment; electric power equipment will be installed to replace present steam operation.

Mo., St. Louis—The F. A. Kauffman Mfg. Co., 100 South Second Street, plans installation of electric power equipment in connection with proposed rebuilding of four-story vinegar manufacturing plant, recently destroyed by fire with loss reported in excess of $80,000.

Mont., Terry—The Common Council is said to be planning the installation of pumping machinery in connection with proposed municipal waterworks to cost about $35,000. T. R. Atkinson, Bismarck, N. D., is consulting engineer.

Neb., Ashland—Swift & Co., Union Stock Yards, Chicago, Ill., meat packers, are reported planning a one-story ice-manufacturing plant at Ashland, to cost close to $30,000, with equipment.

Neb., Lincoln—The Iowa-Nebraska Light & Power Co., Ninth Street, is completing plans for one-story steam-operated power plant unit at Ninth and K Streets, to cost about $125,000, with equipment. Company engineering department, Davenport, Iowa, is in charge.

Nev., Fallon—The Common Council is reported considering the installation of a municipal electric light and power plant to cost close to $100,000, with equipment.

N. J., Newark—The United Color & Pigment Co., 158-78 Mount Olivet Avenue, has filed plans for one-story addition to boiler plant, reported to cost about $21,000, with equipment.

N. Y., Brooklyn—The "New York Times," Times Square, New York, will install electric power equipment in new four-story printing plant on Third Avenue, Brooklyn, for which plans have been filed, entire project to cost close to $1,000,000.

N. Y., Brooklyn—The Rubel Coal & Ice Corporation, 937 Fulton Street, has plans nearing completion for a one-story ice-manufacturing plant on West Twenty-first Street, reported to cost about $100,000, with equipment. Henry J. Nurick, 44 Court Street, is architect.

N. Y., Endicott—The International Business Machines Corporation, 50 Broad Street, New York, plans installation of electric power equipment in proposed addition to plant at Endicott, reported to cost more than $100,000.

Ohio, Canton—The Canton Rolling Mill Corporation, recently organized to take over the local plant of the Carnahan Sheet & Tin Plate Co., plans installation of electric power equipment in connection with proposed extensions and improvements to cost about $500,000. C. M. Easterly is vice-president.

Ohio, Carrollton—The Tuscon Tire & Rubber Co., Carrollton, plans installation of electric power equipment in proposed rebuilding of three-story factory, destroyed by fire Oct. 29, with loss reported in excess of $250,000.

Ohio, Cleveland—The Acme Refining Co., 3591 West Fifty-sixth Street, plans installation of electric power equipment in proposed two-story grease and oil plant, entire project to cost $140,000.

Okla., Blackwell—The City Council is planning extensions in municipal electric light and power plant including installation of a 2500 kw. turbo-generating unit, with auxiliaries, estimated to cost about $75,000. A public election will be held Nov. 12, to vote on the proposition.

Ont., South Porcupine—The Dome Mines Co., South Porcupine, plans installation of electric power equipment in connection with proposed rebuilding of milling plant, recently destroyed by fire with loss of more than $1,000,000. Jules S. Bache is president.

Pa., Mount Holly Springs—Curtis & Brothers Co., Newark, Del., paper manufacturer, will install electric power equipment in connection with extensions and improvements in mill of the Mount Holly Paper Co., Mount Holly Springs, recently acquired, entire project estimated to cost more than $85,000.

Pa., Philadelphia—The American Ice Co., City Center Building, will soon break ground for a one-story ice-manufacturing plant at Eighteenth Street and Limekiln Pike, reported to cost more than $25,000, with equipment.

Tenn., Franklin—The Tennessee Cereal Co., Franklin, plans installation of electric power equipment in proposed new plant unit for which plans have been approved, entire project to cost $100,000. B. W. Ernst is president.

Texas, Denison—The Kraft Cheese Corporation, Denison, plans installation of electric power equipment in connection with extensions and improvements in local plant, entire project reported to cost $100,000.

Texas, El Paso—The Nichols Copper Co., 25 Broadway, New York, has approved plans for the construction of a one-story power plant at its new refinery at El Paso, reported to cost close to $100,000, with equipment.

Va., St. Charles—The Benedict Coal Corporation will install electric power equipment in connection with an expansion and improvement program at its coal properties, including new tipple and other mine units.

Wash., Shelton—The Rainier Pulp & Paper Co., Shelton, plans installation of electric power equipment in proposed addition to local mill, entire project reported to cost more than $400,000. Headquarters are at 534 Battery Street, San Francisco.

W. Va., Morgantown—The North Pole Ice Co., 614 Gaston Avenue, Fairmont, W. Va., is perfecting plans for the construction of a two-story ice-manufacturing plant at Morgantown, with initial capacity of about 30 tons per day, reported to cost close to $60,000, with equipment.

W. Va., Wellsburg—The Pillsbury Flour Mills, Inc., Minneapolis, Minn., will install electric power equipment in new paper bag manufacturing plant at Wellsburg, for which plans have been approved, reported to cost $140,000, with machinery.